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Summary of First Regional Workshop on Dredging, Beach Nourishment, and Birds on the South Atlantic Coast

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Abstract: The U.S. Army Corps of Engineers (Corps), the American Bird Conservancy (ABC), and the U.S. Fish and Wildlife Service (USFWS) organized a workshop on February 1-4, 2005 at Jekyll Island, Georgia. The primary goal of the workshop was to disseminate information on the beneficial use of dredged material deposition along the South Atlantic Coast for the purpose of habitat improvement, management, and conservation of colonial and non-colonial waterbirds and shorebirds. This region involves the operations of five Corps Districts including the Jacksonville, Florida, Wilmington, North Carolina, Savannah, Georgia, Mobile, Alabama, and Charleston, South Carolina, Districts. The workshop was characterized by a series of presentations from numerous Federal, state, and conservation organizations actively involved in the monitoring and managing of dredged material deposition for the beneficial use of habitat improvement for birds and other wildlife species. The workshop began with several presentations that identified birds of conservation concern and their habitat relationships along the Atlantic Coast (Session I). The presentations then focused on the impacts of beach nourishment (Sessions II-VI), and the use of dredged material islands by colonial and non-colonial waterbird and shorebird species (Session V). The final Session (Session VI) focused on the importance of small and regional-scale monitoring efforts, and available resources to access databases and general information on coastal bird conservation. In general, the presentations highlighted the status of current efforts to promote bird conservation in Corps operations, and emphasized areas where improvements can be made. These areas include: 1) Identification of important inlets and other areas for birds along the Atlantic Coast; 2) Link current conservation of birds in the South Atlantic Coast District regions with regional bird conservation plans already developed; 3) Improve data acquisition, database storage and accessibility; 4) Engage local communities to promote conservation alongside of recreational and economic interests; and 5) Improve our abilities to integrate issues of scale, including local, regional and national impacts of Corps activities on the conservation of many waterbirds and shorebird populations.

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Preface

This technical report summarizes the results of a regional workshop dealing with coastal dredging and beach nourishment operations of the U.S. Army Corps of Engineers (Corps) and bird conservation held during 1-4 February 2005, in Jekyll Island, Georgia. The information presented is derived from presentations made during the workshop by representatives of the Corps, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS) (Biological Resources Division), American Bird Conservancy (ABC), and various state agencies, universities, and non-government organizations (see Appendix A for author names and affiliations). These presentations represent the views and opinions of the presenters and do not necessarily reflect the views or policies of the Corps. The workshop was organized jointly by ABC, the Engineer Research and Development Center, Environmental Laboratory, and the USFWS.

At the time of publication of this report, Commander and Executive Director of ERDC was COL James R. Rowan. Dr. James R. Houston was Director.

1 Introduction

The U.S. Army Corps of Engineers is responsible for managing and maintaining navigable coastal and inland waterways of the United States. It is also the primary agency responsible for shoreline protection. Activities associated with waterways maintenance or shoreline protection, including dredging, dike construction, dredged material disposal, beach nourishment, and variable dam discharge actions, potentially conflict with Federal, state, and interagency mandates to protect populations of breeding, wintering, and migratory waterbird and shorebird populations, several of which are listed as Federal or state endangered, threatened, or species of regional concern. Conflicts between Corps operations and bird conservation can result in a lack of operational flexibility and increased costs for Corps projects. However, many of these projects often provide excellent opportunities for bird habitat creation, maintenance, or restoration. Whether these projects become conflicts or opportunities for bird conservation is strongly influenced by communication among agencies and organizations involved in the planning, construction, and post-construction monitoring phases of Corps projects. Increased education among agencies regarding bird habitat requirements and project-oriented logistical considerations will help improve communication and coordination among agencies and lead to more positive benefits for bird conservation during large coastal projects.

This workshop is the first of four planned regional workshops that address issues concerning Corps coastal activities and bird conservation. This workshop covers the South Atlantic Coast, from the Virginia—North Carolina border to south Florida. Subsequent workshops are scheduled to be held over the next two years, and will cover the North Atlantic Coast (Fall 2005), the Gulf Coast (Winter 2006), and the Pacific Coast (Summer 2006). Workshop participants represent a diverse group of ornithologists, engineers, project planners, coastal ecologists, geomorphologists, state and Federal regulators, and other specialists. Numerous representatives of many different Federal, state, and local agencies and non-governmental organizations attended this workshop. The primary objective of the workshop was to expand the capabilities of the Corps to contribute to various bird conservation efforts, to make the bird conservation community aware

of opportunities that exist through working with the Corps, and to address and reduce areas of conflict.

This 4-day workshop consisted of 41 presentations and facilitated discussions during eight different sessions. The first day of the workshop focused on the wintering ecology of Piping Plovers (*Charadrius melodus*) and a separate proceedings document will be prepared by the USFWS. This technical report summarizes the presentations from the workshop that focus on dredging, beach nourishment, and bird conservation. These presentations represent the views and opinions of the presenters and do not necessarily reflect the views or policies of the Corps. Presentations are summarized in their chronological order and PowerPoint files for many of the presentations are available online at:

<http://el.erdcl.usace.army.mil/dots/coastalbirds.html>.

2 Session I: South Atlantic Coastal Bird Status and Distribution

Conservation Priority Bird Species of the Atlantic Coast — *William C. Hunter*

Bird species considered to be a high conservation priority along the Atlantic coast were identified using information from the American Bird Conservancy's Green List and by using the Partners in Flight continental and regional criteria. This information is derived from the existing *Southeastern Coastal Plain-Caribbean Shorebird Conservation Plan* and the soon to be released *Southeast U.S. Waterbird Conservation Plan* (contact the author for more information on these). Eight breeding species are highlighted here as being both of continental and regional concern, and an additional two breeding species have been identified as of regional concern only, and one breeding species as of continental concern only. An additional two breeding species are of regional stewardship responsibility. In addition, among non-breeding (transient or wintering) species, 10 are highlighted here as of continental or regional concern, or both (however there are other species of conservation concern).

Continental and Regional Concern Breeding Species

Snowy Plover (*Charadrius alexandrinus*): This is a cosmopolitan species with approximately 100,000 individuals worldwide, 16,000 of which occur in United States (2,400 along the Gulf Coast, and 800 in Alabama, Mississippi, and Florida). Florida's Gulf Coast supports about 215 pairs. The low population of these birds makes them highly vulnerable, and human-based disturbances are likely serious causes for future concern in all beach-nesting populations.

Wilson's Plover (*C. wilsonia*): Recreational use of beaches may negatively impact this species; in addition several times nests and chicks have been run over by 4-wheelers driven by sea turtle biologists. Despite these problems, the current population size for the Southeastern Coastal Plain and Peninsular Florida of about 1500 pairs appears stable, but the species is considered vulnerable to further declines.

Piping Plover (*C. melodus*): This Federally endangered species continues to warrant attention. Along the South Atlantic Coast, numbers of nesting pairs were as high as 50 (in the 1980's, most in North Carolina), but more recent numbers are about 20 pairs. This species is likely very sensitive and has declined mostly from areas with heavy recreational use, though proximate causes of declines are still not clear.

American Oystercatcher (*Haematopus palliatus*): This species occurs from the Maritime Provinces of Canada into Latin America and the West Indies. Approximately 11,000 individuals now occur in the United States proper. In the Southeastern U.S., 1,875 pairs breed along both the Gulf and Atlantic Coasts, with about 1,200 pairs from Florida (both Atlantic and Gulf coasts) to North Carolina. Many northeastern birds migrate to winter in the southeastern U.S. This species is sensitive to disturbance and is considered vulnerable because on average a pair may take up to 4 years to successfully fledge one young. Coastal breeding habitat has been greatly reduced; however, no significant population decline has been detected for this long-lived species.

Gull-billed Tern (*Sterna nilotica*): Approximately 10 percent of the world population of this species occurs in the southeast along the Texas and Louisiana coast. An additional 1,000 pairs are estimated to breed along the coast of South Carolina to Florida. A species that nests on beaches, it is highly vulnerable to human-based disturbances. In contrast to other species, Gull-billed Terns feed predominately on flying insects or terrestrial animals; how this figures into the species' relatively low population size is unknown.

Roseate Tern (*S. dougallii*): Approximately 600 adults of this Federally threatened species breed in the Florida Keys, with most individuals nesting on rooftops. Most nesting of this species in North America occurs in the New England area, where it is also a Priority species. Birds in the Florida Keys appear to be a northern extension of the West Indies populations. As gravel rooftops are being phased out, this species should be considered highly vulnerable to future declines in Florida.

Least Tern (*S. antillarum*): Most conservation efforts have focused on the endangered interior subspecies of Least Tern, currently estimated at about 17,000 birds, but that population appears to be stable, at least along the Mississippi River. Although more numerous at about 36,000 birds from

Texas to North Carolina, the non-listed coastal subspecies may be today much more vulnerable to future declines. Recent research suggests that this species experiences little or no reproductive success on disturbed beaches. Of the 50 percent of all coastal nesting pairs now nesting on gravel rooftops, 90 percent of those occur from Florida (both Gulf and Atlantic coasts) north to North Carolina. This indicates continuing habitat degradation along the beaches, but the projected phasing out of gravel rooftops spells further trouble for this still common but beleaguered species.

Black Skimmer (*Rynchops niger*): A year-round resident in the southeast, only about 20 percent or less of the world's population of this species breeds in the southeast. While populations declined during the 1970s, numbers currently appear to have stabilized. Nevertheless, this species will likely experience continuing population declines as human-based disturbances increase on beaches used for nesting.

Regional Concern Breeding Species only

Common Tern (*S. hirundo*): An uncommon breeder in the Southeast, less than 1 percent of the world population breeds along the North Carolina coast, but this is among the most rapidly declining beach-nesting species and is therefore of regional concern in the Southeast.

Sandwich Tern (*S. sandvicensis*): This species overall has experienced population declines, but numbers may be increasing or stabilizing in some are parts of the range. U.S. populations breed largely along the Gulf Coast in Louisiana and Texas; some breed east along the coast of the Carolinas and Virginia.

Continental Concern Breeding Species only

Willet (*Catoptrophorus semipalmatus*): Regional population trends appear stable; however, this species tends to nest behind beaches and may be vulnerable to habitat loss through current development pressures along coastal areas.

Regional Stewardship Breeding Species only

Brown Pelican (*Pelecanus occidentalis*): Overall, population increases have been recorded nationwide for this species, and it has been delisted in

many states. However, this bird is still state listed in Mississippi, Louisiana, and Texas, and there are localized declines in portions of Florida and South Carolina. The southeast United States supports approximately 45 percent of the national breeding population (about 90,000 birds) from Texas to North Carolina.

Forster's Tern (*S. forsteri*): Isolated breeding populations of this species are separated: one along the Gulf Coast (particularly along the Texas and Louisiana coasts) and the other in North Carolina, north to Delaware. Together these two populations support about 20 percent of the world's population for this species.

Continental and Regional Concern Transient and Non-breeding Species

Piping Plover: Recent estimates are of approximately 6,000 individuals range-wide, and all either migrate through or winter along the Atlantic and Gulf coasts of the southeastern U.S. This total population size for a shorebird represents one of the lowest counts for any species.

Long-billed Curlew (*Numenius americanus*): This bird was once the second most common curlew in 1800s. It typically breeds in the western Great Plains and Great basin today, but formerly also the eastern Tallgrass Prairies of the mid-west U.S. (which is now almost all converted to cornfields). Supposedly the large numbers formerly wintering in the southeastern U.S. were from this now lost breeding population. Currently, only about 400 birds winter in southeast, east of the Mississippi River.

Whimbrel (*N. phaeopus*): This bird is identified as a Regional Concern shorebird owing to declining overall populations and potential threats on migration stopover areas in the southeast. During migration, approximately 18,000 birds concentrate on stopover areas in the southeast (particularly important is the Altamaha Delta in Georgia).

Marbled Godwit (*Limosa fedoa*): Most populations of Marbled Godwit breed in the Prairie Potholes region and winter along the Gulf Coast. However, east of the Mississippi River, about 2,000 birds regularly winter along the coast. These birds may represent the isolated James Bay breeding population. As with all shoreline-dependent species, the Marbled Godwit is vulnerable to declines from loss in habitat quality at inlets along the southeastern U.S. coastline.

Red Knot (*Calidris canutus*): About 10,000–12,000 birds winter in the Southeast and these may represent a separate subspecies from the birds that migrate to southern South America. Despite the steep population declines being documented for the South American wintering subspecies, the Southeastern U.S. wintering subspecies appears to be stable at present. Nevertheless, when all Atlantic Flyway Red Knots are considered together, the Southeastern U.S. wintering birds are increasing in importance as the South American wintering populations plummet. That said, Southeastern wintering Red Knot populations are subject to future population declines, with loss of habitat quality at inlets along the Southeastern U.S. coastline and with increasing frequency of beach nourishment projects. The more frequent the beach nourishment is (i.e., 1–3 year cycles), the more likely that invertebrate prey populations will have difficulty recovering.

Sanderling (*Ca. alba*): This bird is experiencing population declines, though numbers may have stabilized during recent years.

Common Loon (*Gavia immer*) / Red-throated Loon (*G. stellata*): Both of these species are susceptible to injury and death from accidental consumption of fishing gear and other man-made debris.

Horned Grebe (*Podiceps auritus*) / Northern Gannett (*Morus bassanus*): Population declines have been suggested for Horned Grebe, but Northern Gannetts appear to be increasing overall on breeding grounds. Nevertheless, both of these species are also subject to entanglement with fishing gear and large numbers of dead and dying gannets have been reported in recent years. However, these deaths may be more associated with temperature inversions resulting in changes in food fish availability.

Summary

Conservation efforts towards these species could be assisted greatly with collaborative efforts among conservation agencies, non-government organizations, and the U.S. Army Corps of Engineers (Corps). Conservationists need input from the Corps to address questions concerning beach nourishment and other Corps activities along the Atlantic and Gulf Coasts. Specific issues concerning beach nourishment include when and where sand is deposited, and the source of the deposited sand. Increasingly important, however, may be the frequency at which a beach is nourished. More frequent re-nourishments may lead to permanent collapses of invertebrates associated with tidal beach environments, which in turn may lead to

greatly decreased food resources for shoreline-dependent birds. These issues still need further research to confirm and predict impacts; however, such impacts have ramifications for the long-term quality of the nourished beach, and the eventual use of the beach by nesting or wintering birds. Poor planning and design of beach nourishment projects have the potential to negatively affect bird populations. However, beach and shoreline restoration projects, including beach nourishment and dredged material deposition, have the potential to create important habitat especially for nesting birds and other wildlife when habitat needs of these species are incorporated into the restoration process.

Waterbird Use of Sandbars and Emergent Sand Spit Islands on the Georgia Coast — *Brad Winn*

Unaltered waterways along the Georgia coast provide open sand beach habitat in the form of emergent sandbars and spit islands. These natural open sand habitats constitute less than 1 percent of the available beaches, yet support 100 percent of all Georgia beach nesting birds. The entire Georgia Barrier Island System extends approximately 100 miles and contains 14 barrier islands; four of these islands are Federally owned and managed, while another four are state owned and managed. Examples of man-made islands along the Altamaha River include Little Egg Island and Pelican Spit. Both islands are part of a depositional area for dredged material. All beaches from ordinary high waterline down are accessible by the public. These beaches generally have a shallow slope (4 ft/mi) from the shoreline, with a 6–9 ft tidal area. These conditions provide open sand areas and mud flats used by many birds.

Many emergent sandbars and spit islands become important nesting, loafing, and roosting areas. During the nesting season, 33 species of shorebirds, seabirds, and wading birds were observed. Percentages of nesting birds detected on emergent spit islands are provide below:

- Wilson's Plovers (*Charadrius wilsonia*): 35 percent on spit islands.
- Royal Terns (*Sterna maxima*): 100 percent on spit islands; 14,000 estimated total in Georgia.
- Brown Pelican (*Pelecanus occidentalis*): 100 percent on spit islands; 6,000 estimated total in Georgia.
- Sandwich Tern (*S. sandvicensis*): 100 percent on spit islands; 600 estimated total in Georgia.

- Gull-billed Tern (*S. nilotica*): 100 percent on spit islands; 100 estimated total in Georgia.
- American Oystercatcher (*Haematopus palliatus*): 35 percent on spit islands; 60 estimated total in Georgia.
- White Pelicans (*P. erythrorhynchos*): Emergent spit islands also provide important loafing areas.

Recreational use by the general public was found to significantly disturb loafing habitat during the 1990s; one of three Georgia seabird colonies were lost, including the elimination of Pelican Spit Island. In 1998, the Georgia Department of Natural Resources Board passed the Bird Island Rule for the protection of breeding, migrating, and wintering birds (particularly Gull-billed Tern and Black Skimmer (*Rynchops niger*) colonies). This rule gives complete protection for three spit islands and partial protection for two other islands. Since 1998, two additional spit islands have formed, but are not currently protected.

Mid-winter waterbird surveys were conducted along the Georgia coast from 1996–2005. The general protocol directed 70 volunteer surveyors to conduct counts 1-1/2 hours before and after high tide during the last 2 weeks of January. Specific information collected included location, species, number per species, and roost locations for each species. Results show a year-to-year consistency among the data. Winter birds tend to use areas at the north or south tip of the spit islands and these areas are often at creek entrances with sand deposition. Loafing sites of winter birds tend to be undisturbed areas with low predation rates, where birds would forage on inter-tidal shoals.

Several migrants were observed between 1996 and 2004 on the Georgia coast barrier islands, particularly Red Knots (*Calidris canutus*) and Whimbrels (*Numenius phaeopus*). Red Knots were observed on Wolf Island, and a few other islands, during August and September. Counts ranged from 5,000 to 12,000 individuals and the birds were observed to feed on exposed sandbars with a diet consisting largely of Dwarf Clams (*Mulinia lateralis*).

Whimbrels are observed throughout the salt marshes and barrier islands of Georgia during April and May, and in lesser numbers in July and August. These large shorebirds feed almost exclusively on fiddler crabs (*Uca pugnax*) during the day, then move to specific sandspit islands to

roost during the night. While the total number of Whimbrels staging in, and moving through, Georgia in the spring is not known, there may be as many as 5,000–10,000 individuals during the height of the staging period in May. A record number of birds (5,000 individuals) was observed on one island. These small, dynamic, and mostly unvegetated sand islands along the Georgia coast are considered key habitat for Whimbrels during the spring staging period while they are on their way north to Arctic nesting areas.

Are Atlantic Coastal Inlets a Sustaining Habitat of Non-breeding, Migratory Shorebirds? — *Brian Harrington*

Estuary and inlet sandbars are an important wildlife resource. Inlets are known to be important to migratory birds, yet are increasingly used as sand sources during beach nourishment operations. To exemplify the importance of inlets, data were analyzed from the International Shorebird Survey (ISS). This volunteer program monitors coastal areas in the Western Hemisphere. In the United States, through the assistance of 800 cooperators, over 50,000 surveys have been conducted since 1979. Surveys were conducted by volunteers every 10 days, from 1 July through 1 October, using standard protocols. Additional information was obtained from a winter study of American Oystercatchers (*Haematopus palliatus*). From these data, numbers and distribution of coastal shorebirds during the non-breeding season were evaluated along the Atlantic coast in several southeastern states, including North Carolina, South Carolina, Georgia, and Florida. Over 360 sites were compared, with 107 sites classified as inlets, and 254 sites classified as beach or other.

Results identified five species that consistently preferred inlets (“Inlet-loving Species”) to other habitats. Although inlets represented a fraction of the habitat available, these species consistently had higher counts on inlets. These species include the American Oystercatcher, Piping Plover (*Charadrius melodus*), Wilson’s Plover (*C. wilsonia*), Red Knot (*Calidris canutus*), and the Short-billed Dowitcher (*Limnodromus griseus*). Data from wintering American Oystercatchers showed significantly more birds on sand islands and spits associated with inlet and estuary habitats. Some species were detected more often in coastal habitats (e.g., Black-bellied Plover [*Pluvialis squatarola*]), while other species were detected more often in other habitats types, such as marsh areas (e.g., Black-necked Stilt [*Himantopus mexicanus*]). Species richness and overall counts were also higher on inlets during the survey period. As a group, abundance and

richness of coastal species was significantly higher on inlets than non-inlet habitats. These results also suggest that inlets provide important habitat to migrating and wintering shorebirds. Continued use of sand from inlet sources for beach restoration and nourishment needs to be reevaluated and studied. Removal of sand from inlets may reduce a highly important and limited habitat resource vital to many imperiled shorebirds during the non-breeding season.

Seasonal Dependence of Red Knots on Coastal Inlets of Northeast Florida — *Doris Leary and Pat Leary*

The Red Knot (*Calidris canutus rufa*) has experienced significant declines during the past several decades. This species undertakes a dramatic biannual, trans-hemisphere migration and often congregates in large numbers in widely separated locations. The Delaware Bay area is well known to support large numbers of Red Knots during migration, and the winter population in Chile has reached as high as 60,000 birds. International marking and banding studies have contributed to our understanding of the complex biology and natural history of these birds. These birds stop seasonally in northeast Florida (Nassau Sound and Fort George Inlets) during spring and fall migration, and provided us with the opportunity to study marked birds during the migration season. Spring migration occurs between March and May, and about 1,500 to 1,600 in-spring birds can be detected at specific sites. Fall migration occurs between August and September, and about 300 to 600 birds are detected. Numerous birds banded in South America are detected in northeast Florida, and these birds stay for approximately 2–3 weeks during spring migration, and about 3 weeks during fall migration (but in lower numbers). During this period, these birds are dependent on bivalves (*Donax* spp.).

From research conducted in northeast Florida, record numbers of Red Knots were recorded at the Fort George inlets in May 1974 (1,500 birds), May 1975 (1,300 birds), February 1981 (1,466 birds); at the Talbot Island State Park in May 1989 (1,500 birds); at Big Bird Island in April 1999 (200 birds); and at the Bird Islands—Ft. George Inlets in May 2004 (1,500 birds). Red Knots were found to double in weight during the seasonal stopover; they foraged on bivalves, and most individuals migrated to Chile for the winter. These birds represent “jump migrants,” and individual birds cover approximately 500 km between staging areas during migration. No banding data were collected prior to the 1990s, but with the use of digiscope images, numerous birds with South American bands were

observed in 2003 and 2004. In August 2003, three birds with South American bands were detected, then 14 banded birds were detected in May 2004. Principal areas where birds were banded in South America include banding sites at Los Alamos Beach, Rio Grande, and Tierra del Fuego, in South Argentina. One banded bird from Lago doPeixe, Brazil, was observed in May 2004 (the bird was banded in 1984 and was resighted in 2004; this constitutes a record age for the species). Birds sighted in Florida were also re-sighted during subsequent years, and in areas as far north as Mispillion Harbor, Delaware, and Fortescue, New Jersey. During the spring, birds cross the Atlantic and often arrive in Delaware in poor condition. High numbers of juveniles were detected in 2004, suggesting a good year for the species.

3 Session II: Overview of Beach Nourishment on the Atlantic Coast

Design and Compliance Issues for Beach Nourishment and Beach Disposal of Dredged Material – *Daniel Small*

Dredging and beach nourishment and bird conservation issues for the South Atlantic Division of the U.S. Army Corps of Engineers (Corps) are discussed. The South Atlantic Division includes the Wilmington District (Delaware), Charleston District (South Carolina), Savannah District (Georgia), Jacksonville District (Florida), and the Mobile District (Alabama). The Corps planning activities for this division focus on ocean-side issues including:

- Beach erosion.
- Disposal of dredged material.
- Sand management.
- Beneficial use placement.
- Emergency projects (e.g., restoring existing projects after hurricanes along the south Florida Gulf Coast).

These activities often require the removal and re-placement of sand along oceanside beaches. Sand sources may include inlets and island spits used as roosting and foraging sites by shorebirds. The cost/benefit of removing sand from other areas remains unknown at this time; more research is needed. Forming collaborative partnerships with government and non-government agencies involved with bird conservation would help address the potentially negative impacts of Corps activities on bird populations.

Shoreline Projects

These are often concerned with protection of beach resources. An example would be Coney Island, New York. The basic process includes establishing a design for beach nourishment, identifying the berm profile and existing beach system, placing dredged material on the beach, and distributing sand in dunes or berms, consistent with existing system.

There are four phases in Project development:

- Planning.
- Design.
- Construction.
- Operations and maintenance.

The Corps Civil Works Project Development Process includes an authorization phase that completes a reconnaissance of the proposed project location and examines the feasibility of the proposed project. During these phases, the Corps is involved in the formulation and final design of the proposed project. After the feasibility of the project has been confirmed, then the process progresses to the design and construction phases. Corps activities during these phases include the initial construction, monitoring, and renourishment actions.

The basic features of the oceanside Civil Works Planning process are:

- Process oriented.
- Established process.
- Iterative steps.
- Multidisciplinary.
- Collaborative.

Beach nourishment may involve regulatory issues and permits may be given to other organizations. The process is different from past efforts that focused largely on military and harbor access. Currently, the process focuses on civil works projects that are often concerned with residential beach nourishment and protection projects.

The Civil Works Planning process follows six basic steps: 1) identify problems and opportunities, 2) inventory and forecast conditions, 3) formulate alternative plans, 4) evaluate effects of alternative plans, 5) compare alternative plans, and 6) select recommended plan.

General design considerations for shoreline protection projects include:

- Protection of life and property.
- Local sponsors.
- Publicly accessible beaches.
- Detailed studies.
- Design berm and dune profile.

- Specific vertical–horizontal dimensions.
- Sand resources must meet design requirements.
- Maximum sand retention on beach.
- Design impacts on upper beach face.
- Designed borrow areas.
- Planned beach dressing.

General considerations for the disposal of dredged material on beaches are:

- Environmentally acceptable.
- Disposal of routine maintenance dredged material.
- Beneficial uses.
- No dune creation.
- Low berm (high water seaward to littoral zone).
- Spatial limits — disposal placement profile.
- Material returns to the littoral system.
- Placement site — certain radius of dredging site.
- Construction features — limited effort for beach dressing (e.g., normally no planting).

Beneficial placement of dredged material is an important consideration during the process. Placement of dredged material near shore can have the benefit of allowing the natural movement of material to restore important features. The dredging process removes sediment from offshore, transports these sediments to the beach, and then places them on the beach according to the design specifications. An example of nearshore deposition of dredged material for beneficial uses is Galliard Island, in Mobile Bay, Alabama. This island was designed to accommodate waterbird colonies as well as dredged material deposits.

During beach nourishment operations, two types of dredges are often used: 1) hydraulic cutterhead dredge, which is placed no more than three miles offshore, and uses submerged pipelines to pump the material onto the beach through 32-in. pipes, and 2) hopper dredge, which is a self-contained seagoing vessel that pumps sediment into onboard “hoppers” for transport to near-shore pump out stations. Then, front-loaders are used to move material on the beach. The hopper dredge permits the use of sand resources farther from the shore.

Corps oceanside activities must comply with numerous Federal environmental laws and regulations including:

- National Environmental Policy Act (NEPA).
- Endangered Species Act.
- Fish and Wildlife Coordination Act.
- National Historic Preservation Act.
- Coastal Zone Management Act.
- Magnuson Fishery Conservation and Management Act.
- Clean Water Act Section 404 (Discharge of Dredged Material).
- Section 401 (Water Quality Certification).
- Coastal Zone Management Act and State Coastal Programs.
- Clean Air Act.

Shoreline and colonial waterbirds

General planning and design considerations are as follows:

- Determine existing conditions.
- Determine existing uses.
- Determine environmental windows.
- Monitor before and after Corps activities.
- Avoid existing bird habitat or colonies.

All Corps projects must conform to the Corps Environmental Operating Principles (EOPs). These principles are an integral part of Corps mission objectives and the decision making process, are aspects of all Corps programs, and are inherent in the planning process and project initiation. The EOPs are also consistent with the National Environmental Policy Act and other environmental statutes. The Corps also views the EOPs as means of establishing collaborative relationships that work towards environmental sustainability, that seek balance and synergy, and that assess the cumulative impacts of operation activities. From these collaborative relationships, the Corps and partners share common missions, common understanding of the issues involved, and provide a basis for knowledge management.

The EOPs are stated below:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all circumstances.
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that affect human health and welfare and the continued viability of natural systems.
- Seeks ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.
- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.
- Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

For further information, knowledge management websites are listed below:

- USACE Threatened, Endangered, and Sensitive Species Protection and Management system: <http://el.erdc.usace.army.mil/tessp/>
- NOAA Beach Nourishment Web Site:
<http://www.csc.noaa.gov/opis/html/bchsand.htm/>
- Biological Monitoring of Beach Nourishment Operations:
<http://www.nan.usace.army.mil/business/prjlinks/coastal/asbury/index.htm>
- The National Shoreline Management Study:
<http://www.iwr.usace.army.mil/NSMS>

The East Coast Beach Nourishment Experience: The Good, the Bad, and the Ugly — *Orrin H. Pilkey and Andy Coburn*

Beach nourishment involves the introduction or deposition of sand onto a beach by truck or dredge. Target beaches often tend to be large, and, currently, many barrier islands are getting smaller because of erosion and sea-level rise. During the process of deposition, the sand sources must be consistent with the existing beach system. If the sand source is very differ-

ent (e.g., high proportion of seashells), the potential impacts could destroy beach system. An example is Waikiki in Hawaii: nourished beach project used a non-consistent sand source that eroded away and destroyed a nearby reef system.

U.S. Beach Nourishment efforts are occurring along the Gulf Coast and East Coast. On the East coast, beach nourishment operations cost an estimated \$2.7 billion, sand sources ranges from high to low quality, and the costs can be relatively cheap to very expensive. Beach nourishment operations need to avoid ebb tidal deltas and lagoons. Several examples of poor beach nourishment operations exist. First, in Miami Beach, Florida, quartz sand was replaced with carbonate sands, which made it impossible for sea turtles to nest. In Jacksonville, Florida, sand deposition included high concentrations of 'Shell Hash,' which destroyed the recreational value of the beach, plus it negatively impacted natural communities. Several beach nourishment projects in North Carolina ruined high quality beaches, including Oak Island, where depositional material created a 'Cobble stone' beach, and Bogue Banks, where mud was deposited instead of sand.

Beach nourishment activities can impact the near-shore ecosystem, from the meiofauna to crabs, from fish to birds. Generally, the ebb tidal delta sand is the best and cheapest; however, on natural inlets, loss of sand leads to erosion on adjacent islands. Jettied inlets tend to be a good source of sand, and on large tidal deltas (e.g., Jekyll Island, Georgia), sand from offshore sources appears to work well.

However, successful beaches are difficult to define. Re-nourished beaches are often short-lived, and may need to be re-nourished many times. Virginia Beach, Virginia, and Wrightsville Beach, North Carolina, are the most frequently re-nourished beaches (Virginia Beach: re-nourished 48 times; Wrightsville beach: renourished 21 times). Jupiter Beach, Florida, needs to be renourished every 3 years, though the reasons are not well understood. Possible explanations include: 1) storm intensity and frequency, 2) beach density (volume/unit length), 3) beach length, 4) sand grain size, 5) groins, 6) seawalls, and 7) offshore bathymetry. Several methods may be used to measure beach longevity, including renourishment intervals, dry beach width, low tide beach width, and erosion hot spot behavior. Beach systems with poor longevity should be considered poor choices for future or continuing beach nourishment activities.

Beach nourishment activities receive Federal funding for several reasons: 1) storm protection, 2) navigation, 3) emergencies, 4) mitigation purposes, 5) erosion control, and 6) ecosystem restoration. However, many of the beach nourishment efforts are not justifiable. Numerous examples of poor nourishment projects exist, but the Atlantic Beach story, from Bogue Banks, North Carolina, is one of the best examples. Nourishment efforts on this beach deposited vast amounts of muddy sediment essentially ruining the esthetic and recreational value of the area. Basic elements of the Atlantic Beach nourishment effort include the use of dredged material from a harbor as the sediment source. Because Federal funds were used, the cost was essentially free to the local community; however, the Corps was responsible for monitoring the nourishment operations and was expected to halt efforts if the beach became too muddy. Despite the muddy dredged material used, the Corps did not stop nourishment efforts because the local tourism board did not voice any objections during the project.

Lessons learned from the Atlantic Beach project: 1) agreements must be established and followed during the nourishment project, 2) do not rely on the Corps or anyone else, and 3) provisions must be arranged for halting the project if results are not suitable. Overall, numerous state, Federal and local agencies were responsible for the Atlantic Beach mess.

Despite the problems with beach nourishment projects, estimates predict that approximately 5.5 billion dollars will be spent on beach nourishment projects during the next decade. In the long term, the Federal government may step out of beach nourishment efforts, and nourishment efforts will be initiated by local communities. Local communities can conduct beach nourishment activities much cheaper than the Federal government, but the quality is generally poorer. With projected rising sea levels and the increase in human development along coastal areas, beach nourishment costs will become too high for most local communities, leading to a future of seawalls, or the retreat of some local communities from coastal areas.

Numerous research needs exist, but it is unlikely that such research will ever be funded, because the results will be too political. Specific areas of research on beach nourishment that are needed include 1) biological impacts of beach nourishment activities, 2) cumulative biological impacts of repeated nourishment actions, 3) factors that control beach longevity, 3) a serious look at the cost/benefit of proposed beach nourishment projects, and 4) a closer look at the project designs and inevitable impacts.

Piping Plover Habitat Considerations for Beach Nourishment Project Designs — James D. Fraser and Jonathon B. Cohen

This presentation will discuss beach nourishment impacts on Piping Plover (*Charadrius melodus*) habitat and provide ideas to minimize these impacts; these are simple in concept, but are often difficult to put in action.

The Piping Plover is a bird of the intertidal zone, and the interspersed and juxtaposition of key habitats is an important element of high quality habitat for the species. This species tends to forage in moist substrate habitat (MOSH) on the bay-side intertidal zone, where ephemeral pools and moist overwash zones exist. During the winter, this species prefers mudflats, sand flats, and algal flats approximately 74 to 93 percent of the time. During the breeding season, these birds foraged 85 percent of the time in protected MOSH areas during the pre-nesting stage. During the nesting stage, higher densities, higher foraging rates, faster growth, and, sometimes, even better survival is evident for birds nesting near MOSH areas. During the post-nesting stage, fledglings often move to MOSH areas to gain weight prior to migration. These critical MOSH areas are formed by overwash of sediments from oceanside of a bay and they can be affected by beach nourishment activities.

Specific beach conditions found to be important for breeding Piping Plovers include 1) a beach width range of 30–200 m (mean of 140 m along Atlantic coast), 2) a beach slope of around less than 5-8 percent low, and 3) an area of sparse vegetation for nesting. During the winter months, birds tend to use wide beaches with intertidal flats. General recommendations include 1) keeping nourishment substrate similar to original substrate, 2) knowing that sparse vegetation is good for nesting, while dense vegetation is bad, 3) knowing that rock/algae is good habitat for providing foraging cover, and 4) juxtaposition: keep open beach and mud flat foraging habitat together in the area; natural inlets tend to have both habitats available and close together.

When conducting beach nourishment activities, isolate potential habitat from the mainland as much as possible; this will reduce predation. Also, avoid heavily used recreation sites. Overall axiom: if you build it (proper habitat), they will come; but, if you don't practice wise management, they will go.

4 Session III: Beach Nourishment and Piping Plovers

Beach Stabilization and Piping Plovers: Overview of Conservation Issues and Implications for ESA Section 7 Consultations — *David Rabon and Anne Hecht*

Section 7 of the Endangered Species Act (ESA) directs all Federal agencies to consult with the U.S. Fish and Wildlife Service before the agency implements activities (including issuance of permits or funding) that may directly or indirectly affect listed species and/or designated critical habitat. The section 7 consultation process can be used to reduce adverse effects of beach nourishment and other coastal stabilization projects on the threatened Piping Plover (*Charadrius melodus*). Deposition of dredged material (beach nourishment), jetty construction, inlet relocation, and beach bulldozing impede natural coastal processes that would otherwise create and maintain ephemeral pools and sparsely vegetated moist sediment flats that are heavily selected by migrating and wintering piping plovers. These same microhabitats are essential to successful Piping Plover reproduction at the southern end of their Atlantic Coast breeding range. Artificially nourishing beaches often exacerbates threats from public use by increasing beach access.

The conservation strategies outlined in piping plover recovery plans seek to maintain natural coastal processes that perpetuate high quality habitat. High priority recovery tasks include discouraging construction of structures and other developments; discouraging interference with natural processes of inlet formation, migration, and closure; and discouraging beach stabilization projects including construction of artificial “dunes.” While advocating primary reliance on conservation of natural habitat formation processes, the 1996 U.S. Atlantic Coast Piping Plover recovery plan acknowledges the potential role of artificial habitat creation and enhancement as compensation for disruption of natural processes. Implementation to date of such artificial habitat enhancement techniques has been very limited, however, and monitoring and evaluation of results are largely lacking. Beach nourishment projects can be timed to avoid direct impacts of construction on Piping Plovers. Disturbance to Piping Plovers from beach recreation can be reduced through beach management

and community education programs. Pre- and post-construction monitoring and research can refine understanding of impacts and help to improve protection measures.

Piping Plover Utilization of the Mason Inlet Relocation Project Area, North Carolina — William David Webster

Piping Plover (*Charadrius melodus*) use of the Mason Inlet, North Carolina, was monitored before, during, and after an inlet relocation project. During pre-project surveys, 22 Piping Plovers were detected on Mason Inlet during the fall of 2001. During the fall migration and wintering seasons, 15 additional birds were detected at the adjacent Rich Inlet and seven birds were detected on Mason Inlet, including two banded individuals.

Piping Plovers were monitored by the University of North Carolina at Wilmington, beginning in November 2001. Monitoring efforts were conducted on three inlets as part of the Mason Inlet Relocation Project. These inlets include Rich Inlet, Mason Inlet, and Masonboro Inlet. Bird monitoring efforts followed an established path along the perimeter of each inlet, while alternating directions and time of day (tidal regimes) when surveys were conducted. Daily surveys were conducted from January through April 2004, and weekly surveys were conducted throughout the rest of the year during the 3-year study. The data collection effort was standardized and used 3-point running averages for data collected from 2001–2004.

Results indicated that most Piping Plovers were detected on the foraging grounds around low tide, regardless of time of day or weather conditions. Mason Inlet was surveyed twice as much as the other inlets. Approximately 2 to 3 times more birds were observed in 2003 and 2004 than in 2002. No Piping Plovers were detected during late spring or early summer in all 3 years of the project. Fall migration typically peaked in September, while spring migration peaked in March, though seasonal timing of the peak varied among years. During the winter, numerous individuals were detected repeatedly during the 3 years of the project, indicating a returning wintering population.

During spring 2002, observations of birds shifted from the Mason Inlet to Rich Inlet as the relocation project progressed. During the fall 2003, all observations of birds occurred on Rich Inlet. Birds began to return to Mason Inlet by late 2002, and during 2003, Piping Plovers were about

equally distributed on both the Mason and Rich Inlets. By 2003, Mason Inlet had become an important foraging and resting area for Piping Plovers. By 2004, detection of birds on Rich Inlet began to decline.

Standardized, post-project counts of Piping Plovers are higher than pre-project counts. Why? During the relocation project, a sediment basin was filled on the Mason Inlet, forming a tidal mudflat that became exposed during low tide. This area became a high quality foraging area for plovers that was located adjacent to resting and loafing areas. As the project continued, changes occurred in the direction and intensity of the ocean current, causing the Rich Inlet to become scoured and steeper in 2004, reducing available mudflat areas.

Overall conclusions are: 1) that Mason and Rich Inlets are important areas for migrating and wintering Piping Plovers; 2) that Masonboro Inlet is not a good area for plovers because of human disturbance patterns and existing shoreline stabilization structures; 3) spring migrants were disrupted by the construction phase of the relocation project, but winter residents continued to use the Mason Inlet, while spring migrants switched to Rich Inlet during this period; 4) migrating plovers also avoided Mason Inlet during the subsequent fall, but numbers eventually return to pre-project numbers after approximately 8 months; 5) after project completion, the importance of the Mason Inlet to migrating and over-wintering plovers appears to be increasing, while habitat quality on Rich Inlet appears to be decreasing; 6) onshore sediment basins that form mudflats and that are adjacent to barrier island uplands provide the proper mix of habitats for foraging, socializing, and resting or loafing Piping Plovers; and 7) maintenance of sediment basins or continued rotation of sediment basins will be necessary to provide habitat for migrating and wintering Piping Plovers.

Piping Plover Population Regulation on a Rebuilt Island — James D. Fraser, Jonathon B. Cohen, and Lawrence M. Houghton

A study on habitat use by Piping Plovers (*Charadrius Melodus*) was conducted on West Hampton Island, New York. This barrier island was partially destroyed by a hurricane in 1992, and was rebuilt by U.S. Army Corps of Engineers in 1994. This project addressed several questions about the Piping Plover ecology in this area: 1) Is the population regulated, and what is the threshold growth rate? 2) How is the population regulated? and 3) What determines equilibrium density?

Baseline information

The Atlantic Coast population of Piping Plovers has been slowly increasing since 1986; reproductive success during 1992–2001 is approximately 1.34 fledglings/pair nest success. After the hurricane of 1992, the Corps refilled the breach in the West Hampton barrier island in 1994, and the beach was subsequently renourished in 1996, 2000, and 2004.

Preliminary observations

Piping Plovers increased after reconstruction of the island, but subsequent construction of houses reduced the population. We used population modeling to create a model of density-dependent factors influencing Piping Plover population on the West Hampton Dunes. During this study, nesting success of Piping Plovers was monitored daily, the entire habitat area was surveyed thoroughly, and existing literature was used for establishing estimates for rates of immigration and emigration.

Results of the density-dependent model found that the growth rate declined after population was reduced to 8 pairs/ha. Immigration turns to emigration with increases in population density; from 2002 to 2004, lower numbers of breeding birds were returning to the area as the population increased. The 1992 storm created approximately 25 ha of potential nesting habitat, but the Corps doubled this area during the restoration. Initially, the population parameters indicated that birds were immigrating into the population. By 2002, parameters indicated that emigration was beginning.

What factors were influencing equilibrium in density dependence (immigration vs. emigration) in the West Hampton Dunes plover population? Moist-sediment habitat (MOSH) may provide an explanation. After the dune area was restored, low-wave energy during low tides created high quality foraging areas of mudflats, sandflats, and ephemeral pools. In previous studies, the presence of MOSH habitats was important in predicting the presence of breeding plovers, high food abundance, higher fledgling foraging rates, faster growth rate for fledglings (but sample sizes were small), and, in general, higher average fledging survival rates. Also insightful are density comparisons between the West Hampton Dunes area with available MOSH habitat (0.87 ± 0.11 pairs/ha) and an adjacent area with no MOSH habitat (0.57 pairs/ha). The availability of MOSH habitat provides

the initial conditions favoring immigration, yet as density increases, a threshold is reached and emigration becomes evident in the population.

Main points of this research

1) Piping Plover populations on West Hampton Dunes are regulated by immigration and emigration (results may be different if adjacent populations were at equilibrium density); 2) habitat quality (an index to food supply) determines density within a given area of nesting habitat; and 3) territorial behavior limits density. These results suggest that localized plover populations can be managed to maximize density, largely through the addition and management of MOSH habitat. Regionally, reproductive goals should strive to achieve more than 1.3 fledglings/nest to maintain a sustainable population.

5 Session IV: Biological Effects of Beach Nourishment

Design and Biological Monitoring of Constructed Mudflats — *Douglas G. Clarke and Gary Ray*

An intertidal mudflat was constructed at Jonesport, Maine, using dredged material. Few examples of beneficial use of dredged material for mudflat creation exist in the United States, though there have been large-scale projects in Europe and Japan. There is a growing interest in mudflat construction, for example, in the Delaware Bay region to create mudflats as spawning habitat for the declining horseshoe crab (*Limulus polyphemus*) populations. Furthermore, creation of mudflats using dredged material is relatively easy to engineer. Construction of mudflats usually depends on site-specific conditions, availability of funds, volumes of suitable dredged material, transport distances, and other logistic issues.

During the 1960s, local residents of Jonesport, Maine, noted that mudflats promote fisheries in the area. Additional mudflat habitat was created on Sheep Island, when dredged material became available in the 1990s.

Monitoring efforts were then undertaken to address specific questions: 1) Would the created mudflat become a stable, persistent feature of the environment? 2) Would the mudflat support fisheries (through viable clam and baitworm populations)? (A nearby spatial reference area was selected for a control.) Macroinvertebrates were sampled using benthic cores; worms and clams were sampled with rakes. Specific target species were the soft clam (*Mya arenaria*) and clam-worms (*Nereis virens*).

General sequence of events

1) Sheep Island mudflat was constructed in 1989, 2) monitoring of the invertebrates took place during August and September 1990, 3) monitoring continued in 1992 through 1994 (Beals Island only in 1993), and was revisited in 1998. In general, the mudflats remained in place during this time, though rubble was placed along periphery of Sheep Island to reduce erosion. Based on analysis of sediment, the Sheep Island site was different from the reference site and contained higher concentrations of silt and clay. Initially, the benthic faunas at Sheep Island were higher than

the reference site, but by 1990, the faunas became very similar, with comparable biomass measurements.

Populations of the target species showed rapid recruitment on the constructed mudflat at Sheep Island. Abundances of target species at Sheep Island and the reference site may have been biased by frequent harvest of clams by locals during the sampling period.

Overall findings

1) At Sheep Island, a stable (greater than 9 years) mudflat was established, 2) infaunal assemblages were similar to those reported for other northeastern mudflats in terms of diversity, abundance, and biomass, 3) dense soft clam populations were present within two years, and were consistently present during the monitoring period, 4) dense populations of small sand-worms were present consistently during the monitoring period; however, densities of large sand-worms varied greatly between years.

Conclusions

1) Given suitable site conditions and dredged material characteristics, mudflat construction is a viable beneficial use option, and 2) future applications should be monitored and results documented, particularly with respect to habitat functions for bird populations.

Impacts of Dredging and Inlet Bypassing on the Intertidal Ecology of Pea Island National Wildlife Refuge, North Carolina — *Dennis Stewart, Robert Dolan, and Cindy Donoghue*

For 12 years, sand from the Oregon Inlet has been bypassed to Pea Island, North Carolina (Cape Hatteras National Seashore is due north from Pea Island). The Oregon Inlet is the largest inlet on the Atlantic Coast, and in the process of transport, nearly 1 million cubic yards are placed on Pea Island annually. The Oregon Inlet opened 160 years ago, and for the past 20 years, it has been maintained by maintenance dredging. Methods of dredging are to pipeline dredge (bay side), and hopper dredge (ocean side). Bulldozers are then used to shape the beach.

The hopper dredge opens channels and then deposits the dredged material offshore from the origin. Currently, dredged material is dumped about

3 miles south of the inlet in about 10–20 ft of water. The original purpose of Pea Island was to provide habitat for migratory birds, but since implementation of new policies with the National Wildlife Refuges System Improvement Act of 1987, further efforts are needed to determine compatibility of current management practices.

Fundamental questions addressed by current research

- What are the anticipated impacts to the beach?
- Are there any ecological implications?
- Are the changes compatible with National Wildlife Refuge requirements?

Methods

Sand was sampled along transects on the beach: 42 transects were used with six areas sampled along each transect (transects cover 6 miles along beach), for a total of 210 samples. Also, the invertebrate fauna was sampled and monitored during this period. Target species include the mole crabs (*Emerita talpoida*) and clams (*Donax* spp.). Potential impacts of dredged material deposition on Pea Island include burying (likely killing them), accumulation of finer sand grains, and higher percentage of heavy metals. The magnitude of the impacts increased with increasing frequency of dredged material deposition, increased volume of dredged material deposited, and selection of placement site for the dredged material on the beach.

Over time, the trends indicate a decrease in grain size. Material deposited offshore by the hopper dredge slowly accumulated on the beach, but only finer grains make it onto the shore. Also, heavy metal concentration increased while mole crabs decreased in abundance; however, clams and amphipods tended to increase in abundance.

Conclusions

- New method or design for dredged material deposition is a possibility. The Node/inter-node deposition method creates new nodes for dispersal of sediment every 2000 ft, and nodes are varied annually. This method would minimize the repeated annual deposition patterns that are burying target organisms and increasing heavy metals in the soils.

- Need to re-visit dredging moratorium windows to determine periods of lowest and highest biological activity for target species.
- Need continued monitoring efforts. Monitoring data are critical for adaptive management needs, and provide input on compatibility issues with the National Wildlife Refuges System Improvement Act of 1987. Ideally, samples should be collected five times a year; before and after sampling, and seasonal sampling, winter, spring, and early summer.
- Personnel must maintain scientific objectivity; efforts will involve some risk, but rewards of minimizing ecological impacts of dredged material deposition are worth the risk.

Waterbird Use of Offshore Shoals and Possible Species-specific Impacts of How Shoals are Removed – *Doug Forsell and Craig Watson*

Sand from offshore shoals is increasingly being mined to replace sand eroded from beaches. Offshore shoals do not accrete material over time; once gone, they are gone for good. Offshore shoals often provide important foraging grounds for numerous diving waterbirds, including seabirds, loons (*Gavia* spp.), and seaducks. These birds are already affected by human activities, including over-fishing of forage fish, bycatch in gillnets, contaminants, overharvest, and collisions with lighted structures and boats. They may soon also be impacted by other man made structures, such as wind power turbines proposed for offshore waters.

Current Concern

These birds are strongly tied to resources provided by offshore shoals. Many species winter in large numbers along the Atlantic Coast and approximately 20 million birds migrate through the Atlantic coastal waters each year, some utilizing the shoals. These birds are often difficult to survey and owing to their ephemeral use of areas during migration, it is more important to identify bird concentration areas, flyways, and temporal patterns of habitat use than to estimate populations. This study focused on birds that utilize offshore shoals during the winter.

Shipboard surveys using 300-m wide transects are the best methods for surveying seabirds. This method permits data collection on foraging behavior and better detection of diving birds. However, for large areas, it is not cost or time effective to use ships. Therefore, we conducted aerial surveys of 120-m strips from an altitude of 45 m for two winters from December 2001 through March 2003. The U.S. Fish and Wildlife Service

(USFWS) conducted aerial flight surveys in mid-1999; 120-m wide survey lines were used, and surveys were conducted from December 2001 through March 2003.

In the offshore waters, Gulls (*Larus* spp.) were more abundant in the northern areas, loons were distributed relatively evenly throughout the study area, and Northern Gannets (*Morus bassanus*) were most abundant in Virginia's waters. Scoters (*Melanitta* spp.) were most abundant near the mouths of the Delaware and Chesapeake Bays, and they used the outer coastal waters primarily during migration. Results showed that all bird groups were at least twice as abundant in the vicinity of shoals as non-shoal areas, and that Scoters were 10 times more abundant in shoal than non-shoal areas.

Sand Mining efforts are managed by the Minerals Management Service (MMS). This agency has jurisdiction over 3 nautical miles from shore. Some states, the U.S. Army Corps of Engineers, and the MMS are developing 40 shoal mining plans now.

Mining should be limited in areas such as: 1) bird foraging areas, 2) bird concentration areas, 3) bird wintering areas, and 4) migration stopover areas. Efforts are needed to monitor these birds and to better understand their ecological links to the offshore shoals.

Also, there is a need to formalize, develop, and plan a method of mining that minimizes impacts on quality of foraging habitat. Several options may be available:

- Mine top of the shoal: this method would likely reduce upwellings potentially impacting foraging quality for Gannets, Gulls, and Pelicans (*Pelecanus* spp.), and would increase the diving depth for many seaducks with unknown prospects for recovery of benthic invertebrates.
- Mine side of the shoal: this method would maintain upwellings, but would reduce shallow water area of the shoal, lowering the benthic foraging area available to Scoters. Disturbing the sides of the shoals may have unknown, but important impacts on habitat for benthic organisms.
- Mine the middle of the shoal: this would maintain the upwelling, but could potentially affect sedimentation patterns, resulting in change of

substrate and benthic food availability, and it would likely increase the diving depth for seaducks.

- Remove entire shoal: this should occur far away from the shoreline and far from where birds forage. As we do not understand the ecological linkages between birds and shoals, we may be better off to completely remove the shoal until we can predict the impacts on birds. In this case, shoals should be chosen as far offshore as possible and shallow shoals should be avoided.

Recommendations

- Identify bird use of shoals (3 years minimum), including the seasonal and annual pattern, and the magnitude of bird use.
- Determine why birds are attracted to shoals.
- Determine the prey items selected by birds on the shoals, and the impact of shoal removal on these organisms.
- Develop models to predict the expected results of sand mining on shoals.
- Test this model and develop dredging plans that have minimal impacts on bird populations.

6 Session V: Bird Use of Dredged Material

The History of Avian Habitat Creation Through Dredged Material Deposition by the U.S. Army Corps of Engineers — *Michael P. Guilfoyle, Richard A. Fischer, and Mary C. Landin*

Since the 1890s, the U.S. Army Corps of Engineers (Corps) has created over 2,000 man-made islands by depositing dredged material. Most of these islands were created during construction of the Intracoastal Waterway System during the 1930's and 1940's. The purpose of the Intracoastal Waterway System was to promote navigation, flood control, fisheries management, and recreation. The large increase in human development along coastal areas during the past 50 years has greatly reduced the availability of natural beach and island habitat used by breeding, migrating, and roosting waterbirds and shorebirds. Currently, many of these birds now depend upon these artificial islands, with some islands supporting large proportions of the regional breeding populations for some species.

During the 1970s, the Corps' Dredged Material Research Program (DMRP) conducted extensive research on avian use of dredged material islands in seven regional studies. The objectives of this research include:

- Document the use of dredged material by colonial nesting birds.
- Document succession of vegetation on these islands.
- Compare vegetation and bird use on diked and undiked islands.
- Compare vegetation and bird use of natural and man-made islands.
- Study year-round use of dredged material islands by nesting, migratory, and wintering birds.

Here, we summarize results of DMRP funded research conducted between 1974 and 1977 along the entire coastal and estuarine waterways of New Jersey, North Carolina, Florida, Texas, Washington, and Oregon, as well as the shoreline and islands of the Great Lakes; and along the Upper Mississippi River from Alton, Illinois, to St. Paul, Minnesota.

The following is summarized from Soots and Landin (1978). During the research period, over 600,000 nesting colonial waterbirds of 35 species were detected. The majority of colonial species were tree nesters (e.g. Herons [*Ardea* spp., and *Egretta* spp.], Egrets [*Egretta* spp.], Ibises

[*Plegadis* spp.], Cormorants [*Phalacrocorax* spp.], Pelicans [*Pelecanus* spp.], and Spoonbills [*Ajaia* spp.]), but several colonial ground nesters were also observed (e.g., Gulls [*Larus* spp.], Terns [*Sterna* spp.], and Skimmers [*Rynchops* spp.]). In addition, 59 species of non-colonial birds were observed nesting on dredged material islands. Along the Texas, Florida, and North Carolina coasts, the majority of both tree and ground nesting colonial birds were utilizing man-made dredged material islands. However, along the Great Lakes, Pacific Northwest Coast, and the Upper Mississippi River, birds utilized beach and other natural habitats more than man-made islands. Nationally, 45 percent of all colonial ground nesting birds and 30 percent of all colonial tree nesting birds were utilizing man-made islands.

Importance of these islands to populations of breeding waterbirds ranged from critical breeding habitat (e.g., for Gull-billed Tern [*Sterna nilotica*], Common Tern [*S. hirundo*], Least Tern [*S. antillarum*], Sandwich Tern [*S. sandvicensis*], Royal Tern [*S. maxima*], Caspian Tern [*S. caspia*], and Brown Pelican [*Pelecanus occidentalis*]), to relatively unimportant habitat (e.g., for Double-crested Cormorant [*Phalacrocorax auritus*], Anhinga [*Anhinga anhinga*], Glaucous-winged Gull [*Larus glaucescens*], Great Black-backed Gull [*L. marinus*], Western Gull [*L. occidentalis*], Roseate Tern [*S. dougalli*], and Black Tern [*Chlidonias niger*]).

Soots and Landin (1978) summarized general results of all survey work by state:

- Texas: More habitat areas are needed for ground nesters in the northern portion of the state and for tree nesters in the southern portion of the state.
- Florida: Ground nesters need more habitat areas of bare ground, or with sparse and medium herb cover.
- North Carolina: Shrub and forest habitat is needed for tree nesters at river mouths and inlets; bare substrate habitat is needed for terns.
- New Jersey: Habitat is needed for both ground and tree nesters.
- Great Lakes: Common Terns and Herring Gulls (*L. argentatus*) need sparse habitats; habitat is needed for tree nesters.
- Upper Mississippi River: Isolated, bare substrate islands are needed to restore Least Tern populations.

Management recommendations for existing dredged material islands:

- Maintain or reestablish habitats.
- Increase size of islands and stabilize them.
- Change configuration, elevation, vegetation, or other features to create more desirable habitat for colonial waterbirds.

New habitat or islands are needed when:

- Nesting habitat for ground or tree-nesting colonial waterbirds is lacking.
- Alterations to islands have removed important habitat.
- Undesirable nesting habitat (e.g., thick vegetation) must be cleared.

Additional concerns about existing or new dredge deposal islands include issues of island connection to the mainland and existing levels of disturbance. Islands connected to the mainland are poor areas for nesting colonial birds because of high predation rates. Moreover, colonial birds nesting on islands that are subjected to frequent disturbance (e.g., Corps operations or recreational activities) often have low reproductive success and high nest abandonment rates.

Following are basic concepts of new island creation:

- Island should be isolated from predators and humans.
- Island should be created during fall or winter months.
- Island should be at least 2–20 ha in size, with few or no steep slopes, and with a sand/shell substrate.
- Island should be approximately 2 m in elevation (high enough to limit flooding and low enough to avoid wind erosion).

Twenty-one important conclusions of Soots and Landin (1978) remain pertinent today:

1. Each waterbird and shorebird species has life history requirements compatible with dredging operations and island creation when timing and location concerns are accounted for.
2. Habitats for nesting species can be accommodated through placement of dredged material using a rotational strategy for maintenance dredging scheduled operations.

3. Islands between 2 and 20 ha are optimal; however, larger and smaller islands can be successful if isolation, location, topography, elevation, and substrate requirements are met.
4. Slopes of more than a 3-ft rise over 100-ft distance are too steep.
5. Colonies on undiked islands are much more successful than nesting colonies on diked islands.
6. Sand/shell cobble substrates are more desirable than silts and clays.
7. New dredged material should be placed several months before the breeding season to permit wind sorting of material that will provide a firm substrate for nesting.
8. Nesting species can affect vegetation by killing plants through feces accumulation.
9. Undisturbed bare ground habitats are the scarcest in supply in all U.S. waterways, forcing some species to use undesirable habitats, including rooftops and parking lots.
10. Islands should be at least 6–10 ft above mean high water or flood stage during the breeding season.
11. Islands should not be closer than 0.5 miles from the shore to prevent predators and discourage recreational boaters from using island.
12. Some species will only nest close to other species (e.g., Royal and Sandwich Terns).
13. Birds vary in their site tenacity: tree nesting species will persist in an area even when nesting failure is likely; ground nesting species often move from island to island from year-to-year or within a year.
14. Rock, riprap, and steep dike structures are deadly to young birds; young birds need an unimpeded access to the open water and beach habitats.
15. Shallow water feeding habitat close to the island nesting area for breeding adults aids in nesting and fledging success rates.
16. Exotic vegetation will likely require vigorous control to protect nest site integrity.
17. Colonizing nest predators will need to be controlled.
18. Human use of the island will need to be discouraged during the breeding season and islands should be posted with no trespassing signs.
19. Islands can be actively repaired and upgraded using more dredged material during the breeding season if birds can be enticed to relocate to safer parts of the island.
20. Erosion on islands can be controlled using maintenance dredged material, with positive effects on the active bird colonies.
21. Coordination with and education of all interested parties, including local fisherman and environmental groups, should be on-going throughout the

planning, design, construction, and monitoring phases of wildlife island development.

Currently, more than 200,000 metric tons of uncontaminated coastal sediments are dredged each year during port maintenance dredging operations. Therefore, numerous opportunities exist to use this material to create new islands and to restore coastal wetlands, marshes, and beaches. The technology and knowledge to utilize this material to improve habitat conditions for birds already exist, but incorporating this knowledge into standard Corps operations has been difficult. Managing current dredged material disposal islands, and the creation of new islands, where appropriate, should be a priority for dredging operations. Furthermore, interagency and intra-agency cooperation is essential in developing and implementing management guidelines for dredged disposal islands and these efforts should be linked with national and regional waterbird conservation plans.

Despite our good understanding and knowledge of applying dredged material for improving habitat for waterbirds and shorebirds, numerous opportunities for new research exist. Below are some ideas for possible future research efforts:

- Conditions on many dredged material islands have changed since the completion of the DMRP research program: Do these dredged material islands continue to support similar abundance of breeding, migrating and loafing waterbirds and shorebirds? What changes have taken place in the availability of dredged material islands in the Pacific Northwest and the Upper Mississippi River?
- What is the best way to incorporate management and creation of dredged material islands in regional waterbird/shorebird conservation plans? There is a need to monitor dredged material islands and beach nourishment operations.
- The impacts of beach nourishment operations of waterbird/shorebird use on beach and island habitats are poorly understood.
 - Are the impacts short-lived? (time lag effects?).
 - What, if any, are the long-term impacts?
 - How do impacts affect populations at the landscape level?
- We need a better understanding of local and regional impacts of human disturbance on waterbird/shorebird populations utilizing beach and island habitats; increased understanding of these impacts would

help promote long-term management strategies for sustainable colonial and non-colonial waterbird/shorebird populations.

Tern Use of Dredged Materials: Designs for the Creation of Tern Nesting Sites — Walker Golder, David Allen, and Sue Cameron

Variation in the use of dredged material habitats by nesting Terns (*Sterna* spp.) was studied in North Carolina. Several characteristics of Tern nesting habitat are well known, including:

- Nests built on islands and barrier beaches; sometime marshes.
- Nests on bare to sparsely vegetated sites with a substrate of sand, shell, or gravel.
- Need isolation from mammalian predation.
- Need isolation from human disturbance.
- Nesting areas need to be adjacent to foraging habitat.

The use of dredged material can be one of the most effective ways to create, restore, or maintain open, bare sand, or sand-shell habitats on beaches and islands. These islands often mimic their natural counterparts and can provide excellent habitat for nesting Terns. More than 400 dredged material islands exist along the North Carolina coast. Since the creation of these diked vs. undiked islands in the 1970's, Terns have shifted their use to nesting largely on natural beaches and islands. In the 1970's, an estimated 63.5 percent of Terns nested on dredged material islands, but by 2001, this number was reduced to fewer than 5 percent. In 1983, Common Terns (*S. hirundo*) had shifted from use of undiked dredged material islands to natural beaches and natural islands, and this pattern continues through 2001 to today. Gull-billed Terns (*S. nilotica*) slowly shifted away from dredged material islands to natural beach and island habitats by 1997, while the Royal Tern (*S. maxima*) continues to nest primarily on undiked dredged material (constitutes critical habitat for this species).

Not all dredged material islands are the same. Several features of dredged material islands and the management of these islands may explain why many Tern species have shifted to natural beach and island habitats. First, relatively large dredged material islands are too difficult to maintain, and vegetation quickly overwhelms the site, creating poor nesting habitat conditions for Terns. Moreover, diked dredged material islands are used infrequently by most birds because these areas tend to have finer grained

sediments that are not used much by Terns or other birds as nesting substrate. Also, riprap or sand bags should not be used, or should not be visible (below mean water level), because these structures can block beach access for fledglings significantly reducing overall survivorship and reproductive success of the colony. In some cases, steep slopes may need to be included, especially when large amount of dredged material must be deposited. However, most Terns can accept breeding areas with a slope of a 1 m rise per 3 m distance, then a leveling off area. In general, the shape of a dredged material island does not seem to have any influence of the use of the island by birds.

Management, maintenance, and monitoring of dredged material islands require several considerations. First, islands should be created or maintained (e.g., new dredged material added) approximately 4 weeks before the arrival of breeding terns. Otherwise, maintenance operations will disrupt the breeding cycle — don't dump dredged material on nesting birds! The use of signs, posts, and rope may be necessary to warn off potential public recreational use of the beaches and islands during the nesting season. Signs should be about 1.5 m in height (in the face!), because low signs tend to be ignored by the public. Cooperation with the local enforcement agencies is required, and efforts to educate the public will be necessary.

Maintenance of dredged material islands will require planning. It will be critical to re-apply additional dredged material over the subsequent years because of increased vegetation or erosion. Understanding successional patterns occurring on dredged material islands will help in establishing guidelines for island maintenance. In approximately 7–10 years, vegetation will become too dense for most breeding terns. In general, Least Terns will nest on newly created or maintained dredge material islands for up to 4 years; Common Terns, up to 6 years; and Gull-billed Terns, up to 4–7 years. Royal Terns will often nest in grassy areas and may continue to nest on a dredged material island for up to a decade or more.

Partnerships and collaborations can be very important in determining the success or failure of creating and maintaining dredged material islands. Examples from North Carolina include Ferry Slip and South Pelican Islands. During one instance, Brown Pelicans had arrived unexpectedly early and had begun breeding. With early consultation during the island maintenance process, deposition operations were able to avoid areas with nesting Pelicans, and the birds were tolerant of activities when deposition

occurred ± 100 m from colony. Both Ferry Slip and South Pelican Islands were overgrown with vegetation before maintenance operations began; 13 years had gone by since the last deposition of dredged material on Ferry Slip Island. After application of dredged material, both islands were used by breeding Royal and Sandwich Terns: first year — 575 breeding Royal Terns/Sandwich Terns; second year — 2,500 Royal Terns/Sandwich Terns; third year — 3,500 Royal Terns/Sandwich Terns.

Beach nourishment operations may also create open sand habitat useful for Terns. For example, on Wrightsville Beach, 178 Least Terns nests were recorded during the breeding season after beach nourishment. Over 400 nests combined were found for all Tern species.

General recommendations for the creation and maintenance of dredged material islands and beaches in North Carolina include:

- Location: Island should be isolated from mammalian predators, and protected from human disturbance.
- Substrate: Beach-quality sand, shell, or gravel must be used; avoid mud and silt.
- Size and elevation of the island: Maximum size of 15 ha is manageable; with a maximum elevation of 5 m.
- Slope: A relatively gentle slope of a 1 m rise over 3 m should be used (may be difficult if large amounts of dredged material must be deposited).
- Timing: Island and operation should be completed approximately 4 weeks before arrival of birds.
- Planning: Need to plan for long-term management, maintenance and monitoring of the island bird community.
- Collaborations: Mechanisms for partnerships, communication, and cooperation should be created; these efforts will provide better management and maintenance of the islands.

The Jacksonville District's Migratory Bird Protection Program — *Bill Fonerek*

In 1994, during a maintenance dredging operation in the Tampa Harbor, Florida, the U.S. Army Corps of Engineers (Corps) was depositing the dredged material onto a disposal area during the breeding season of several migratory shorebirds. Observations confirmed that nesting was being disturbed and the operations halted. Since this time, the Jacksonville

District has taken a proactive approach to monitoring and managing dredged material operations to benefit migratory birds. A committee consisting of Jacksonville District personnel, the Florida Fish and Wildlife Service, the Tampa Port Authority, the Audubon Society, and the U.S. Fish and Wildlife Service was formed to ensure that the Corps complied with all regulations pertaining to migratory birds, including the Migratory Bird Act, the Federal Endangered Species Act, the Wildlife Regulation Implementation (50 Code of Federal Regulations [CFR]), and the Florida Threatened and Endangered Species Act. This committee formulated the Migratory Bird Protection Policy for the Jacksonville District. Initially, this policy was directed towards the Tampa Harbor operations, but with closer attention to migratory birds and the acquisition of survey data, the protection policy was implemented on all Corps projects. The State of Florida was supportive of the efforts of the Jacksonville District to protect migratory birds, and adopted and extended the Migratory Bird Protection Policy to all permit applications as well.

Specific features of the Migratory Bird Protection Policy include the following:

- Daily monitoring of dredged material islands and operations (April 1 – August 31).
- Certification of monitoring efforts by qualified personnel.
- Routine monitoring reports during the efforts.
- Establishment of flush zones and buffers around identified nesting areas.
- Limited public access to protections zones during the nesting season.
- Postponement of dredging operations or access to islands until after the nesting season has been completed.

Initial shorebird surveys were conducted by the National Audubon Society in the Tampa Harbor, and they found eight species of interest on two dredged material islands, including the Clapper Rail (*Rallus longirostris*), American Oystercatcher (*Haematopus palliatus*), Willet (*Catoptrophorus semipalmatus*), Laughing Gull (*Larus atricilla*), Caspian Tern (*Sterna caspia*), Royal Tern (*S. maxima*), Sandwich Tern (*S. sandvicensis*), and Black Skimmer (*Rynchops niger*). Since this time, 34 species of migratory birds have been observed on dredged material islands in the Jacksonville District. For further information on the Jacksonville District Migratory

Bird Protection Policy, go to the following website:

<http://www.saj.usace.army.mil/pd/mbpp.htm>.

- Lessons learned: cooperation with state agencies and non-government organizations led to the development of the Migratory Bird Protection Policy; this has greatly improved our understanding of migratory birds and our need to monitor impacts of maintenance dredging operations.
- Awareness: we must be aware of migratory birds and the state and Federal regulations with which we comply.
- Regulations can stop projects: ignorance is no excuse; regulations exist for a reason.

Long-term Bird Use of the Craney Island Confined Dredged Material Site — Ruth A. Beck

Craney Island is a dredged material confined disposal facility (CDF) located approximately 2-1/2 to 2-1/4 miles inland along the James and Elizabeth Rivers near Portsmouth, Virginia. The island was established in 1950 by the U.S. Army Corps of Engineers to accept the dredged material obtained through routine dredging operations along the navigational portion of the rivers. Long-term monitoring of the avian communities has occurred on these islands since 1974. Data collected during monitoring efforts include avian use during the breeding, migratory, and wintering seasons.

Brief History of Bird Management Efforts

1974–1987

There was a mutual lack of understanding and cooperation between Corps and biologists; varying degree of avian nesting success during this period.

1988

Bird Habitat Management effort was initiated, which led to the establishment of appropriate Least Tern (*Sterna antillarum*) habitat.

- Corps created five sites with habitat for Terns.
- Personnel from William and Mary College attracted Terns using decoys to three of five sites.
- A strong public outreach effort was initiated.

1989

First pair of nesting Piping Plovers (*Charadrius melodus*) led to management efforts and a memorandum of understanding (MOU) between the Corps and William and Mary College.

1989 to present

Close cooperation with periodic planning meetings.

Present

Threats still exist; current threats to nesting birds include 1) changing habitats, 2) avian and mammalian predators, 3) human disturbance (dredging contractors), 4) flooding, and 5) some fishermen activities.

The Craney Island CDF consists of three large cells: North Cell, Center Cell, and South Cell. Dredged material is deposited in a 3-year cell rotation. Dredged material deposition can create good habitat with suitable substrates for the Least Tern. Furthermore, vegetation is controlled by reapplying dredged material. However, the location of the birds on the island can change year-to-year, depending upon the rotation schedule of the deposition activities. When the Least Terns arrive in April, areas are closed to the public, buffer zones are established to protect the nesting birds where possible, and signs are posted to keep the public out of critical nesting sites. Observations during the nesting season have documented the use of many shells in the Tern nests, and, based on foraging observations, the vicinity around Craney Island has an excellent prey base, promoting a high reproductive success rate for nesting Terns.

Dredged material is deposited continuously at the Craney Island facility year-round. It has been our experience that dredged material deposition operations and nesting birds can co-exist. Management efforts include plans for all seasons, including managing cells for nesting, migrating, and wintering seasons. For example, water levels in the cells can be raised during the migration season, and lowered during the wintering season. On occasion, the site has supported large numbers of birds; for example, on one evening approximately 18,000 birds (mixed species flock) spent an evening at the site. Other management concerns include a *phragmites* removal program to protect vital wetland habitats from this noxious, introduced plant.

Predation on nesting birds has become a challenging management problem. Four years ago, the Red Fox (*Vulpes vulpes*) population increased greatly and became a problem on the island. Other predators include the Herring Gull (*Larus argentatus*), Laughing Gulls (*L. atricilla*) (a problem on another site because of the large population), and even Ruddy Turnstones (*Arenaria interpres*) that occasionally prey on Terns during migration.

The current management approach includes seven principle features:

1. Yearly joint planning sessions with a Corps representative.
2. Creating suitable habitat for beach nesting species using dredged material.
3. Continued maintenance of sites.
4. Identifying, posting, and protection of all active nesting sites.
5. Frequent monitoring of the seasonal bird communities.
6. Managing and controlling predators.
7. Producing weekly reports and recommendations to on-site management of cells.

Summary of avian management efforts on the Chaney Island CDF — the good, the bad, and the ugly

Good

Habitat creation using dredged material works; the maximum of 287 pairs of nesting Least Terns constitutes the most successful Least Tern site in Virginia, in addition, there were five pairs of nesting Piping Plovers.

Bad

Predation has been significant, especially from foxes, feral cats, and wild dogs; predation control has had limited or no success.

Ugly

Greater than half of the shoreline foraging area has been removed because riprap has been added; this is particularly important for the Piping Plover. Moreover, increased dredging operations are removing the 3-year rotational cell concept; now all three cells receive dredged material every year. This practice is adversely impacting previously successful nesting sites.

Thinking Outside Box: A New Paradigm for Management of Dredged Material Islands in North Carolina — *Trudy Wilder, David Allen, Sue Cameron*

During the 1970's, personnel at the U.S. Army Corps of Engineers (Corps), Wilmington District, North Carolina, recognized the value of dredged material to increase and improve habitat for nesting colonial waterbirds. Use of dredged material for the creation of bird habitat has been incorporated in the Wilmington District's dredging program ever since. Early on, innovations were needed to manage material, including the control-of-effluent vs. diking the islands.

Through the innovative thinking of Corps biologists and engineers and coordination with resources agencies, the control-of-effluent method of disposal became the method of disposal of beach quality dredged material. This method allowed material to be controlled using bulldozers and other earth moving equipment to construct an island without dikes or steep side slopes. The Wilmington District realized that coordination with resource agencies to gain knowledge of bird nesting habitat was a key factor. This coordination eventually led to the creation of the North Carolina Colonial Waterbird Database and the development of the North Carolina Colonial Waterbird Management Plan and Memorandum of Agreement between the Wilmington District and other state and federal resource agencies. Key periods in the development of our current dredged material and colonial waterbird management plan are listed below:

- 1976: The Corps funded a study conducted by the University of North Carolina – Wilmington on the effects of diking dredged material islands on coastal bird life in North Carolina (Parnell et al. 1978).
- 1983: The Corps funded continuing studies and surveys of colonial waterbird habitats and nesting populations in North Carolina (Parnell et al. 1986).
- 1986: The Wilmington District funds the University of North Carolina – Wilmington to create a Colonial Waterbird Database (Dr. Parnell).
- 1988: Colonial Waterbird Management Plan and Committee established through a Memorandum of Agreement between the Corps Wilmington District, other Federal and state agencies.
- 1988 – Present: Continue funding surveys on a 3-year cycle along with other resource agencies for the continuation of the Colonial Waterbird database now managed by the North Carolina Wildlife Resources Commission.

The management strategies implemented from the 1970s through 1990 are as follows:

- Consider proper elevation, acreage, timing, and habitat needs as part of the maintenance dredging and disposal activity.
- Implement control-of-effluent method of disposal to benefit colonial waterbirds (e.g., no diking) for beach quality sandy material.
- Coordinate disposal of dredged material deposition sites with key resource agencies.
- Avoid nesting season 1 April – 31 August.
- Continue to monitor and survey bird populations on the dredged material islands.

These management strategies have resulted in successful bird nesting islands throughout North Carolina and increased the percentage of nesting birds from approximately 43 percent in 1991 to 65 percent in 2004.

Suitable nesting islands have been created and nourished in 1) Old House Channel and Channel to Wanchese in the vicinity of Oregon Inlet, 2) Manteo (Shallowbag) Bay, 3) Big Foot Slough near Ocracoke in Core Sound, 4) Wainwright Slough, 5) Hatteras/Rollinson Channels, 6) Back Sound to Lookout Bight near Harkers Island, 7) Drum Inlet, and 8) in the Cape Fear River. These islands have provided needed disposal areas and ways of beneficially placing material so that nesting sites for colonial waterbirds continue to be available. Up until recently, the majority of the islands received dredged material on a 1- to 4-year cycle, with grasses and shrub controlled as needed to provide bare sand nesting habitat. This was a perfect marriage between beneficial use of dredged material and the creation of bird nesting habitat. The dilemma we face today is the funding of the maintenance of the channels that provided the material to the bird islands is no longer available. Wainwright Island in Core Sound (originally on a 4-year maintenance cycle) has not received material since 1996 and is not scheduled for at least the next 2 years. This island has been hit by hurricanes and high winds and has not been re-nourished. Private ownership of islands along Old House Channel and Channel to Wanchese also complicates devising and implementing management plans for birds within this area.

Because new funding for maintenance of dredged-material islands is minimal, a new paradigm is needed to fund and manage dredged-material

islands. In the past, management of islands used by nesting birds was an indirect accomplishment of the Corps during the operations to maintain Federal navigation channels. Now we need to think out-of-the-box, and think of bird management needs as the main objective and goal rather than clearing of a navigation channel. The material needed to sustain the bird island is readily available within the adjacent Federal navigation channel. The future needs of these vital bird nesting sites will require working together, thinking of innovative management strategies and directions, such as:

- Continue to work according to the 1988 Colonial Waterbird Management Plan; conducting surveys and annual meetings.
- Agency participation to consider and discuss management of islands for colonial waterbirds.
- Develop new funding strategies for management of bird nesting sites. Pursue innovative management strategies.
- Management of islands as waterbird nesting areas will be easier to ensure if they are owned by the state; signs must be posted around islands to keep out the public during peak nesting activities.

Endangered Species Coordination and Shorebird Habitat Restoration Features of Murrells Inlet Navigation Project, South Carolina –
Alan Shirey, Robin Collier-Socha, Jimmy Hadden, Ed EuDaly, Paula Sisson, Steve Roff, and Keith Windham

The Murrells Inlet Navigation Project in South Carolina was designed and constructed during the late 1970s and early 1980s. Characteristics of this project are as follows:

- Its purpose was to provide shallow draft navigation for commercial fishing.
- Initial construction was completed in 1981.
- Entrance channel was 3,000 ft (914 m) long, 300 ft (91 m) wide, and 10 ft (3 m) deep.
- Inner channel was 3 miles (4.8 km) long, 90 ft (27 m) wide, and 8 ft (2.4 m) deep.
- Rock jetty, 3,445 ft (1,050 m) lies north of channel.
- Rock jetty, 3,319 ft (1,012 m) lies south of channel.
- Sediment deposition basin is approximately 31/2 ac (1.4 ha).

During the construction of the inlet, dredged material was deposited on Garden City Beach and Huntington Beach State Park. During this phase, there was a concern about management of threatened and endangered species. Consultations with the U.S. Fish and Wildlife Service focused on endangered sea turtles and the Sea Beach Amaranth (*Amaranthus pumilus*) (an endangered plant). Other issues included beach compaction, the monitoring of bird nests, and any potential impacts of the project on the availability of critical wintering habitat for the Piping Plover (*Charadrius melodus*). Nesting areas for waterbirds were delineated, as well as areas for Amaranth sites and seed sources (on Garden City Beach).

The monitoring of endangered species on the beaches indicated a decline of Amaranth on Garden City Beach and a relatively stable population on Huntington Beach State Park (augmented by propagated plantings). During the pre-project stage, there were no nesting shorebirds on Huntington Beach and low winter counts of Piping Plovers (average of 3–4 individuals), Sanderlings (*Calidris alba*) (average of 5–10 individuals) and Black-bellied Plovers (*Pluvialis squatarola*) (average of 2–8 individuals).

During the post-project stages, numbers of breeding and wintering birds increased dramatically because of the increase in available habitat through dredged material deposition. New species breeding on the site include Wilson's Plover (*C. wilsonia*) (average of 2–3 individuals), American Oystercatcher (*Haematopus palliatus*) (average of 1–2 individuals), Willet (*Catoptrophorus semipalmatus*) (average of 3–4 individuals), and Least Tern (*Sterna antillarum*) (average of 2–3 individuals). Large numbers of wintering birds were also observed during the post-project phase, including Piping Plover (average of 6–10 individuals), Sanderling (average of 15–30 individuals), Black-bellied Plover (average of 20–25 individuals), Ruddy Turnstone (*Arenaria interpres*) (average of 10–15 individuals), Short-billed Dowitcher (*Limnodromus griseus*) (average of 200–250 individuals), Dunlin (*Ca. alpina*) (average of 300–350 individuals), Black Skimmer (*Rynchops niger*) (average of 40–50 individuals), Red Knot (*Ca. canutus*) (average of 30–35 individuals), Least Sandpiper (*Ca. minutilla*) (average of 5–10 individuals), Western Sandpiper (*Ca. mauri*) (average of 5–10 individuals), and the Semipalmated Sandpiper (*Ca. pusilla*) (average of 40–50 individuals). In addition, post-breeding adult and juvenile Least Terns (average of 40–50 individuals) were also observed.

These results indicate that proper planning and placement of dredged material can be used to greatly increase bird numbers and species diversity of both breeding and wintering waterbird and shorebird populations. Currently, these areas are beginning to erode and further deposition of dredged material may be needed in the future.

Folly River Dredging Project and the Creation of Seabird Habitat on Bird Key Stono Heritage Preserve, South Carolina — *Felicia Sanders, Tom Murphy, Mark Spinks, Alan Shirey, Robin Collier-Socha, and Jimmy Hadden*

The Stono Inlet in South Carolina drains the Folly, Kiawah, and Stono Rivers. Bird Key Island, located at the mouth of the Stono Inlet, is a small, unstable, shifting island of approximately 20–30 acres (8–12 ha) and has been present in the inlet since the late 1700s. Bird Key Island is an important area for birds in the state for several reasons:

- The island is one of only four or five nesting sites in South Carolina.
- During the 1980s, this island supported Brown Pelicans (*Pelecanus occidentalis*), Black Skimmers (*Rynchops niger*), Terns (*Sterna* spp.), and Gulls (*Larus* spp.). (3,251 Brown Pelicans nested here in 1982.)
- During the late 1980s through 1994, the island supported the largest Brown Pelican colony in the United States (about 4,000 birds).
- The island supports approximately 41 percent of all South Carolina nesting seabirds.
- The island supports numerous nesting shorebirds.
- The island supports numerous wintering Piping Plovers (*Charadrius melodus*).
- The island was designated as a South Carolina Department of Natural Resources Heritage Preserve in 1983 (island became eroded by this time).
- The island was designated as an Audubon Important Bird Area (IBA) by the national Audubon Society in 2004.

The Folly River Navigation project was originally constructed in 1979. The project begins at the Folly River and Creek, and ends at the Atlantic Ocean. The project is approximately 9–11 ft (3–4 m) deep and 80–100 ft (24–30 m) wide, and provides shallow draft for the commercial shrimp industry. Dredged material from this project was originally placed on Folly Beach. However, since the erosion of Bird Key Island (75 percent of Brown Pelican nesting habitat had eroded away by 1983), the South Carolina

Department of Natural Resources and the U.S. Army Corps of Engineers (Corps) proposed to deposit dredged material sand on the island.

Results of the 1983 decision are as follows:

- The Corps District Engineer concluded that depositing dredged material on Bird Key Island will not jeopardize listed species.
- Conclusions from consultation with the U.S. Fish and Wildlife Service provides a Biological Opinion that no harm will occur if dredged material is deposited on the island.
- Dredged material was already used to enhance Pelican habitat in North Carolina.
- The South Carolina Heritage Trust Advisory Board voted to permit application of dredged material to Bird Key Island rather than Folly Beach.
- In 1984, Corps deposited dredged material on landward-side of the island on the nesting area (22,000 yd³ of clean, coarse sand was added to island).

Channel Maintenance for the Folly River Navigation Project is as follows:

- From 1984 to the present, the Corps deposited sand from project onto Bird Key Island.
- The sand resource is shared with Folly Beach.
- Sand is deposited every 1 to 3 years (1985, 1987, 1988, 1990, 1991, 1992).
- Deposited sand added to the island size averages 14,000 to 50,000 yd³.
- Sand is deposited during the non-breeding season (15 October to 1 April).
- The location of dredged material is the most stable site on island.
- The dredged material is redistributed each year.
- The dredged material maintains physical integrity of the island.

Other problems with the island began in 1993. During the winter of 1993–1994, additional dredged material was deposited. However, a high rate of erosion that winter contributed to the loss of 50 percent of the available nesting area. During January 1995, the island became completely intertidal. Numerous colonial waterbirds declined in South Carolina from 1993 to 1995, including the Royal Tern (*S. maxima*) (52 percent decline), Sandwich Tern (*S. sandvicensis*) (37 percent decline), Gull-billed Tern

(*S. nilotica*) (40 percent decline), and the Brown Pelican (24 percent decline). Numbers continued to decline during the 1995–1996 seasons for the Royal Tern (34 percent decline), Sandwich Tern (4 percent decline), Brown Pelican (9 percent decline) and the Black Skimmer (30 percent decline).

In 2000–2003 more dredged material was put on Bird Key Island. Now, a variety of habitats is available including 4–5 ha vegetated dune habitat (for Pelicans and Gulls), 1–2 ha shrub habitat (for wading birds), and 4–5 ha of barren sand habitat (with less than 25 percent ground cover and less than 20 cm vegetation height) (for Terns and Gulls). Between the 2002 and 2005 nesting seasons, large quantities of dredged material have been added to the island, and a considerable amount of habitat is available, but bird populations have yet to recover. Numerous islands receive heavy human recreational use in the area, and some islands have a bad avian tick problems (but not Bird Key Island), but reasons for the poor recovery of birds on Bird Key Island has not been fully explained.

Beneficial Uses of Dredged Materials and Regional Sediment Management: Mobile District — *William Vern Gwin and Larry Parsons*

Maintaining navigable waterways in the Mobile District requires frequent dredging operations. Nationally, several hundred million cubic yards of sediment must be dredged from ports, harbors, and waterways each year to promote and maintain commercial trade, national defense, and recreation. Traditionally, dredged material was discharged into confined disposal facilities, or dumped elsewhere in the waters of oceans, rivers, lakes, wetlands, and estuaries. Currently, there is a real shortage of suitable areas to deposit dredged material, yet efforts to create new disposal facilities are extremely expensive in terms of the political, real estate, economic, and environmental costs. Identifying other uses for dredged material is a viable option of disposal to lower cost and minimize conflicts of creating new disposal facilities. Beneficial use of dredged material has historically been towards projects that build or expand existing land-uses, including airports, ports, residential, and commercial developments. Dredged material is now considered beneficial for a multitude of uses, including creating or expanding nesting and foraging areas for regional populations of water-birds and shorebirds. Regional sediment management goals focus on keeping dredged material in its natural system and to manage deposition operations to limit and minimize any adverse effects.

The Mobile District of the U.S. Army Corps of Engineers (Corps) actively promotes beneficial uses of dredged material, and employs a full-time manager to address dredged material management and disposal. The Mobile District often relies on upland disposal sites to accommodate current and future dredging needs. Since the 1980s, upland disposal sites have been rapidly approaching capacity and new ideas and innovations, including the reuse of existing disposal areas, will be needed to meet future disposal requirements. Since the inception of the beneficial use program within the Mobile District, dredged material has been used to create wetlands, to perform soil manufacturing tests, nourish area beaches, to support industrial uses in the asphalt industry, and to provide fill for large public works projects.

An example of a well-known island made with dredged material is Galliard Island, in Mobile Harbor, Alabama. This island was built during the creation of the Theodore Dredged Material Island. Galliard Island is a diked island with contained sediment that was removed from the natural system. This island has proven to be an important resource for regional bird populations. Specific benefits of Galliard Island to Alabama and to regional bird populations are as follows:

- It is credited with the recovery of the Brown Pelican (*Pelecanus occidentalis*) (4,700 birds nested on the site in 1977); this species was dropped from the Endangered Species List in 1986.
- It is Alabama's only nesting area for Laughing Gulls (*L. atricilla*), Royal Terns (*Sterna maxima*), Caspian Terns (*S. caspia*), and Sandwich Terns (*S. sandvicensis*).
- It also supports nesting Herring Gulls (*L. argentatus*), Gull-billed Terns (*S. Nilotica*), Common Terns (*S. hirundo*), Least Terns (*S. antillarum*), and Black Skimmers (*Rynchops niger*).
- It supports numerous other breeding and wintering birds, including large numbers of migratory waterfowl.

Other areas of concern in the regional management of dredged material deposition occur along the Louisiana Coast area, New Orleans District. This district is concerned with vanishing wetlands caused by an influx of saltwater along the Gulf Coast. Currently, managers are investigating the possibility of importing sand from other dredged material sites (e.g., Tombigbee and Black Warrior Rivers) to restore wetlands along Louisiana coast.

Along the Northern Gulf of Mexico, there are 375 miles of coastline that requires a regional sediment management perspective. The basic philosophy of sediment management along this coast is as follows:

- Change from project-specific management to regional scale management.
- Adopt a holistic approach to sediment management along the Gulf Coast.
- Promote informed management decisions.
- Establish regional goals including:
 - Maximize beneficial use of sediments.
 - Minimize harmful environmental impacts.
 - Optimize expenditures.

Each year, the Corps moves 250–300 million cubic yards of dredged material sediment at the cost of more than \$700 million.

Another example of a regional management approach is Perdido Pass, Alabama. The Mobile District wanted to modify the current disposal practices, utilize more effective sand bypassing practices, and monitor the performance of these changes. Some goals were accomplished with the use of a hydrodynamic model of coast sediment processes. Benefits of the management changes included downdrift replenishment of the beaches, and a reduced need to rehandle sediment, and the changes promoted storm damage mitigation, plus the effort benefits the creation and maintenance of dunes, beaches, and turtle habitat, while keeping the sediment in the littoral system. During 2004, hurricane Ivan destroyed Piping Plover (*Charadrius melodus*) habitat in the inlet; the question now is, “Why not rebuild lost habitat?” Currently, the U.S. Fish and Wildlife Service is initiating the process and developing plans for establishing a new island to promote Piping Plover habitat.

On the Escambia River, in Florida, the Corps used an old disposal area to improve existing habitat and create wetlands. The Corps created a diked area for finer sediments, and plans are underway to create a new wetland with open sand areas. In collaboration with the National Audubon Society, members from the local Audubon Society have agreed to monitor the progress and impacts on the local bird community.

Our conclusions are as follows:

- Regional sediment management approaches are new and benefits may be slow to realize; costs may also be more for regional sediment management.
- It requires a change in management philosophies.
- Cooperation and partnerships are needed among all stakeholders at all levels of planning and management efforts.
- Monitoring is important to document successes and failures of the efforts.
- We must use what has been learned so far to make informed management decisions.

Savannah Harbor Navigation Project Management to Benefit Birds — Steve Calver

The Savannah Harbor Navigation Project is responsible for maintaining the Savannah Harbor navigation channel at Savannah, Georgia. The port consists of 21 miles (33.8 km) of inner harbor channel and 11 miles (17.7 km) of bar channel. The project includes seven active confined sediment disposal facilities (CDFs) that provide approximately 4,800 acres (1,942 ha) for containment of sediments. These disposal facilities receive about 6 million cubic yards of dredged material each year. Over the years, these disposal facilities have become renowned for supporting great numbers and diversity of birds; 289 species have been documented on the sites, and tens of thousands of shorebird and waterfowl may be observed on the sites at any one time during the spring or fall. These areas are known for attracting very rare birds such as the Curlew Sandpiper (*Calidris ferruginea*), Ruff (*Philomachus pugnax*), and Red-necked Stint (*Ca. ruficollis*), and unusual birds like the Roseate Spoonbill (*Platalea ajaja*) and the Reddish Egret (*Egretta rufescens*). Occasionally, a few western species may be detected, including the Western Kingbird (*Tyrannus verticalis*) and the Vermillion Flycatcher (*Pyrocephalus rubinus*). Several state or Federally listed endangered and threatened species, and state species of special concern, are known to utilize habitats and nest on the disposal facilities, including the Least Tern (*Sterna antillarum*), Wilson's Plover (*Charadrius wilsonia*), Ground Dove (*Columbina passerina*), Gull-billed Tern (*S. nilotica*), Little Blue Heron (*E. caerulea*), Black Skimmer (*Rynchops niger*), and Glossy Ibis (*Plegadis falcinellus*), plus several terrestrial species of regional concern including the Bobwhite (*Colinus virginianus*) and the Painted Bunting (*Passerina ciris*).

Although the CDFs are well-known in the birding community as valuable areas for attracting birds, until relatively recently there has been little interest in the district in management for migratory birds. Past management focused on compliance with the Migratory Bird Treaty Act (MTBA). Furthermore, it was difficult to justify the use of navigation project funds to promote conservation of migratory birds. Even the recent Executive Order 13186 that directs Federal agencies to conserve migratory bird populations has had little impact because guidelines for implementing the order have not been established. Because of these constraints, efforts were made to develop a management program to benefit migratory birds at a relatively low cost to the project. This program includes past restrictions to comply with the MBTA and adds additional features based on requirements in a wetland mitigation plan.

The program developed out of a need for additional dredged material disposal capacity. As few practicable sites were available for a new CDF, an existing area previously used for disposal operations was selected. However, this existing area still contained over 300 acres (121.4 ha) of important wetlands. No practical mitigation sites for the loss of these wetlands could be located, so the specific values of the wetlands were identified, and separate mitigation actions were developed to compensate for the wetland function and values lost by construction of the CDF. The mitigation plan identified two primary functions of the wetlands that should be compensated for: fisheries and wildlife habitat. It was decided that bird foraging habitat would be replaced by conducting disposal operations through a rotation plan that actually created more feeding areas for birds. Also, the plan called for the creation of a bird nesting island to increase the value of the area for nesting birds. The mitigation efforts were incorporated into a Long Term Management Strategy (LTMS).

Several aspects of dredged material deposition operations are accounted for in the plan. For example, when dredged material is pumped into a diked contained disposal facility, the area will attract many birds as long as the area remains wet. Nesting success of the birds often depends upon the dredging operation continuing through the nesting season; if dredging operations stop, then the area dries out, and the nesting efforts of the birds may fail. If disposal operations create large sand areas, then many nesting birds may be attracted to the site. These nesting birds may impede disposal and borrow activities. However, depending on the timing and extent of the dredging operations, managers may use stakes and flagging to make

these sandy areas less attractive to nesting birds. Creating protected nesting islands for birds avoids these potential impacts to project operations. Also, the CDFs contain many dikes and roads that must be maintained by mowing. The operations and management guidelines contain a mowing schedule to benefit birds. Many areas along the grassy roads will attract nesting Willets (*Catoptrophorus semipalmatus*). Therefore, mowing schedules were designed to avoid the Willet nesting season when possible, and required mowing during the nesting season is restricted to the actual road surface, to minimize impacts on Willet eggs, nests, and young. Specific elements pertaining to the rotation plan include:

- Within the seven CDFS to receive dredged material, areas will be identified and paired, where one area is used for dredged material deposition for 3 years, allowing the other area to dry for the same period.
- During the use period, water levels will be managed to maximize wildlife habitat value while ensuring the minimal impacts to the disposal operations.

The rotation/mitigation plan provides several environmental benefits. First, the plan creates excellent habitat for resting, foraging, and nesting shorebirds. For example, the Semipalmated Sandpiper (*Ca. pusilla*) feeds in the diked areas; this species is very abundant in spring (totals once approached 35,000 birds), and has lower abundance in fall (usually less than 5,000 birds). Other species benefited by the mitigation plan include the Least Sandpiper (*Ca. minutilla*); very abundant in spring (almost 10,000 birds in one spring), Western Sandpiper (*Ca. mauri*) (almost 7,000 birds in one spring), Lesser Yellowlegs (*Tringa flavipes*), Stilt Sandpiper (*Ca. himantopus*), Peregrine Falcon (*Falco peregrinus*), Northern Shoveler (*Anas clypeata*), Green-winged Teal (*A. crecca*), Blue-winged Teal (*A. discors*), Ring-necked Duck (*Aythya collaris*), Ruddy Duck (*Oxyura jamaicensis*), and the Bald Eagle (*Haliaeetus leucocephalus*).

Bird nesting habitat for shorebirds, waterfowl, and waterbirds (waders) was improved by creating bird islands that provided undisturbed and predator free beach nesting habitats:

- Two 1-acre (0.6-ha) nesting islands were built inside each approximately 1 square mile disposal area.
- One 4-acre (1.4-ha) island was built nearshore waters north of the entrance channel to increase coastal bird nesting habitat.

Important birds observed to be nesting on the interior bird nesting islands include Wilson's Plover, Least Tern, Gull-billed Tern, and the Black Skimmer. The CDFs themselves also support the largest population of breeding Black-necked Stilt (*Himantopus mexicanus*) in the state. The new near-shore island provides a resting place for many species, with especially large numbers of Brown Pelicans (*Pelecanus occidentalis*) roosting on the site before construction was even completed. During its first nesting season, the island supported over 1,700 Royal Tern (*S. maxima*) nests, along with lesser numbers of Sandwich Tern (*S. sandvicensis*), Gull-billed Tern, and American Oystercatcher (*Haematopus palliatus*) nests. During the winter season, these islands are also expected to be used by the endangered Piping Plover (*Ch. melodus*).

7 Session VI: Bird Monitoring and Information Resources

Monitoring Waterbirds: How Can Small-scale Programs Contribute to Large-scale Monitoring Efforts? — *Bruce G. Peterjohn*

Large-scale monitoring efforts, including those at continental and hemispheric scales, exist for many groups of waterbirds. Smaller scale monitoring efforts also exist, and usually cover a particular project or research investigation, or are perhaps at a state level (e.g., state breeding bird atlas efforts). International efforts exist, such as the International Shorebird Survey (ISS) that monitors the distribution of all species, while other some efforts focus on a single species (e.g., the International Piping Plover [*Charadrius melodus*] Census). Colonial waterbirds are often monitored at the state level or through the level of a particular ecosystem (e.g., the Everglades). A larger, national-scale monitoring effort for colonial waterbirds is now being coordinated by the Fish and Wildlife Service (USFWS), and standardized monitoring protocols have been developed for marshbirds and these protocols are now being implemented. Currently, the Program for Regional and International Shorebird Monitoring (PRISM) is attempting to standardize efforts of monitoring all shorebirds.

The specific purposes of PRISM are to:

- Estimate the North American shorebird population sizes.
- Describe shorebird distribution and habitat preferences.
- Monitor long-term population trends.
- Monitor numbers at stopover locations during seasonal migrations.
- Assist managers in meeting conservation goals.

At least 17 individual species are being monitored under PRISM during the breeding season, including the American Woodcock (*Scolopax minor*) (by the USFWS), Piping Plover (*Charadrius melodus*), and the Long-billed Curlew (*Numenius americanus*). Although efforts for single species are limited, the data are good. Information for some of these species is being gleaned from the Birding Bird Survey (BBS), coordinated by the U.S. Geological Survey (USGS), including the Killdeer (*C. vociferus*), Upland Sandpiper (*Bartramia longicauda*), Wilson's Snipe (*Gallinago gallinago*), and

others. Efforts under PRISM are also monitoring non-breeding surveys for the Piping Plover and American Oystercatcher (*Haematopus palliatus*). Surveys during migration are supplementing breeding season efforts to obtain a more comprehensive understanding of migratory bird populations. The migration season sampling effort was proposed in February 2005, and is designed to identify important stopover locations and habitats.

Examples of efforts to monitor birds at large, regional scales include colonial waterbird and marshbird monitoring efforts. Important elements of colonial waterbird monitoring are:

- Periodic regional surveys coordinated by the USFWS.
- State-based surveys (often with variable timing and geographic coverage).
- Local surveys (e.g., university projects, Audubon Society efforts).
- Initiative-based monitoring strategy is under development.

Important features of marshbird monitoring efforts are:

- Standardized survey protocols that are under development.
 - Courtney Conway's methods.
 - Bird Studies Canada Surveys.
 - Salt-marsh surveys.
- Designed for continental monitoring, which is under development.

Data from colonial waterbird monitoring efforts are maintained at the USGS Patuxent Wildlife Research Center, in Laurel, Maryland. These data are gathered and compiled from various sources including the Audubon Waterbird registry, USFWS regional surveys, publications, and ongoing studies. Currently, the database contains information from over 100,000 visits to over 12,900 colonies nation-wide. The USGS manages all the population and demographic data, and these data can be obtained at: <http://www.pwrc.usgs.gov/cwb/database/>. Also, a web-based mapping program is available that provides data on location and other parameters for various colonial waterbirds and other avian groups: <http://mbirdims.fws.gov/nbii/>. Databases from the PRISM monitoring efforts for shorebirds are currently being developed, including a migration database to complement existing breeding data sets. No centralized

database currently exists for marshbird monitoring efforts; databases available are survey-specific.

Numerous smaller-scale research projects around the Nation and elsewhere can make significant contributions to the study of bird populations, including:

- Defining local breeding and non-breeding distribution in a localized area or region.
- Establishing seasonal and geographical patterns of relative abundance.
- Identifying species-specific habitat relationships.
- Documenting breeding and migration chronologies.

However, data from smaller-scale projects, even when compiled into a centralized database, are often limited in applicability to determining larger-scale patterns. For example, data compiled from waterfowl monitoring efforts still yield highly variable trends that are difficult to interpret. Often, these difficulties result because smaller-scale projects are not using standardized monitoring protocols, or data collection efforts are not well coordinated. Data from smaller-scale projects can provide important information for patterns at higher scales, but changes need to incorporate into the way we approach population research. First, efforts need to be defined on the specific population parameter to be measured.

General objectives of most bird population studies include determining the:

- Basic patterns of distributions (initially based on field guides).
- Relative abundance patterns (typically from the BBS).
- Known habitat preferences (from published literature).
- Breeding population (implications for population sustainability).

Regional studies of bird populations often focus on species identified as species of regional or local concern. For example, Partners in Flight (PIF) has identified physiographic regions throughout North America and has developed specific criteria for identifying bird species of concern in these regions. Responsibility of managing and monitoring these species lies at the state or regional level, and data for these species may come from state bird atlases, volunteer projects, and small localized counts (e.g., from

Audubon Society). All these efforts can contribute to state- or regional-based monitoring efforts.

When compiling existing data from multiple sources, data integration becomes a major task. To improve the integration of data from smaller-scale projects, efforts should be made to incorporate studies that utilize comparable methods, and that conduct the surveys at comparable times of the year. Data on the status of bird populations during the non-breeding seasons are generally lacking, and data from these seasons could provide important information for bird conservation. Finally, contributions of multiple small projects throughout a state or region could contribute significantly during the data integration process by identifying the importance of the state or region to the conservation of a species as a whole.

Once the data have been integrated, then the final database needs to be accessible to researches and managers interested in the conservation of bird populations. Accessible databases should provide access to full data sets from completed projects, provide data summaries from ongoing projects, and provide summaries of analyzed results. Moreover, a revolution is occurring on the world-wide web, so these monitoring and data integration efforts could be made available on the internet. This process should also improve communication among various researchers and improve knowledge and understanding about current conservation efforts by the general public.

Information Resources for Coastal Bird Conservation and Project Planning — Casey A. Lott, David N. Pashley, Richard A. Fischer, Virginia L. Dickerson, and Renee R. Caruthers

Large civil engineering projects, such as beach nourishment and dredging of navigational channels, are widespread along the coastlines and large interior rivers of the United States. The biological effects of these projects, and specifically the effects of these projects on bird populations, are complex and vary among regions and ecosystems. In many cases, the biological effects of these projects are only partially understood and the literature on this topic is either poorly developed or hard to find. The results of many important studies are often summarized in agency reports that are not indexed by academic or web-driven search engines. Therefore, high-quality information on the biological impacts of projects that would be useful to planning, project design, and consultations is often difficult to access.

The American Bird Conservancy, in collaboration with the U.S. Army Corps of Engineers (Corps), has identified the need to assemble information on the biological effects of these projects from many gray literature sources into a web-accessible search engine format.

The Corps has recently developed the Threatened, Endangered, and Sensitive Species Protection and Management System (<http://el.erdc.usace.army.mil/tessp/index.cfm>) a web-based tool that contains pertinent information on management of threatened and endangered species on Corps projects. This website can be also be accessed through the Dredging Operations Technical Support (DOTS) website (<http://el.erdc.usace.army.mil/dots/research.html>) and through the Dredging Operations Environmental Research website (<http://el.erdc.usace.army.mil/dots/doer/doer.html>). Currently, a specific link on the site will be devoted solely to the management and conservation of birds. This link is still in development, but will contain information on beach engineering and nourishment, plus the impact of Corps activities on bird habitat. In addition, the Corps has developed the Natural Resources Management Gateway (<http://corpslakes.usace.army.mil/nrm.cfm>), a web-based tool that provides additional information on all Corp projects operations and recreation opportunities. All Corps documents produced during the Dredged Material Research Program (DMRP) that discuss the history, impacts, and management of dredged material deposition will also be available online, plus these documents are contained on the CD provided to all participants at this workshop. The CD also provides a list of internet sites for bird conservation plans, including national and regional shorebird conservation plans that provide estimates of population sizes for individual species. Data fields available on the Corps Gateway site include data in Microsoft Access format, plus data on geographic and taxonomic status of many species. This information is obtainable by using keywords by topic (e.g., habitat, life history, threats, management, etc.).

The Natural Resources Management Gateway will be a useful tool to biologists and engineers involved with large scale conservation planning, long-term project planning, research, and project-specific consultations. We have developed a basic design for this search engine and are in the process of gathering resources, assigning key words to documents, and populating a web-accessible literature gateway to this information.

In the future, we need to interact better with issues of fisheries management; already, there are several pages on the Gateway that identify the impacts of dredging operations on fish and turtles populations. We will also have to improve our abilities to integrate issues of scale, including local, regional, and national impacts of Corps activities on the conservation of many waterbirds and shorebirds. In addition to information on beach nourishment, the National Oceanic and Atmospheric Administration (NOAA), also provides information on the impacts of beach nourishment and other shoreline impacts (<http://www.noaa.gov/coasts.html>).

8 Summary

The U.S. Army Corps of Engineer (Corps), the American Bird Conservancy (ABC), and the U.S. Fish and Wildlife Service (USFWS) organized a workshop on 1–4 February 2005 at Jekyll Island, Georgia. The goal of the workshop was to disseminate information on the beneficial use of dredged material deposition along the South Atlantic Coast for improving approaches to beach nourishment and other Corps operations, for increasing habitat quality along coastal and riverine areas, and for improving our management and conservation of colonial and non-colonial waterbirds and shorebirds. This region involves the operations of five Corps Districts including the Jacksonville, Florida, Wilmington, North Carolina, Savannah, Georgia, Mobile, Alabama, and Charleston, South Carolina, districts. The workshop consisted of a series of presentations from numerous Federal, state, and conservation organizations actively involved in the monitoring and managing of dredged material deposition for habitat improvement for birds and other wildlife species. The workshop began with several presentations that identified birds of conservation concern and their habitat relationships along the Atlantic Coast (Session I), then focused on the impacts of beach nourishment (Sessions II–VI), and the use of dredged material islands by colonial and non-colonial waterbird and shorebird species (Session V). The final Session (Session VI) focused on the importance of small and regional-scale monitoring efforts, and available resources to access databases and general information on coastal bird conservation. In general, the presentations highlighted the status of current efforts to promote bird conservation in Corps operations, and emphasized areas where improvements can be made. These areas include 1) identifying important inlets and other areas for birds along the Atlantic Coast; 2) linking current conservation of birds in the South Atlantic Coast District regions with regional bird conservation plans already developed; 3) improving data acquisition, database storage and accessibility; 4) engaging local communities to promote conservation alongside of recreational and economic interests; and 5) improving our abilities to integrate issues of scale, including local, regional, and national impacts of Corps activities on the conservation of many waterbirds and shorebird populations.

References

- Parnell, J. F., D. M. DuMond, and R. N. Needham. 1978. *A comparison of plant succession and bird utilization on diked and undiked material islands in North Carolina estuaries*, Technical Report D-78-9, Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.
- Parnell, J. F., D. M. DuMond, and D. A. McCrimmon. 1986. *Colonial waterbird habitats nesting populations in North Carolina estuaries: 1983 survey*, Technical Report D-86-3, Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.
- Soots, R. F., Jr., and M. C. Landin. 1978. *Development and management of avian habitat on dredged material islands*, Technical Report DS-78-18, Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.

Appendix A

Table of Presenters, Affiliations, and E-mail contact information

This provides a list of workshop presenters, affiliations, and e-mail contact information from the First Regional Workshop on Dredging, Beach Nourishment, and Birds on the South Atlantic Coast, Jekyll Island, Georgia, 1-4 February 2005.

Table A1. Presenters Who Attended the First Regional Workshop on Dredging, Beach Nourishment, and Birds on the South Atlantic Coast, Jekyll Island, Georgia, 1-4 February 2005.

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14. ABSTRACT The U.S. Army Corps of Engineers (Corps), the American Bird Conservancy (ABC), and the U.S. Fish and Wildlife Service (USFWS) organized a workshop on February 1-4, 2005 at Jekyll Island, Georgia. The primary goal of the workshop was to disseminate information on the beneficial use of dredged material deposition along the South Atlantic Coast for the purpose of habitat improvement, management, and conservation of colonial and non-colonial waterbirds and shorebirds. This region involves the operations of five Corps Districts including the Jacksonville, Florida, Wilmington, North Carolina, Savannah, Georgia, Mobile, Alabama, and Charleston, South Carolina, Districts. The workshop was characterized by a series of presentations from numerous Federal, state, and conservation organizations actively involved in the monitoring and managing of dredged material deposition for the beneficial use of habitat improvement for birds and other wildlife species. The workshop began with several presentations that identified birds of conservation concern and their habitat relationships along the Atlantic Coast (Session I). The presentations then focused on the impacts of beach nourishment (Sessions II-VI), and the use of dredged material islands by colonial and non-colonial waterbird and shorebird species (Session V). The final Session (Session VI) focused on the importance of small and regional-scale monitoring efforts, and available resources to access databases and general information on coastal bird conservation. <div style="text-align: right;">(Continued)</div>					
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14. ABSTRACT (concluded)

In general, the presentations highlighted the status of current efforts to promote bird conservation in Corps operations, and emphasized areas where improvements can be made. These areas include: 1) Identification of important inlets and other areas for birds along the Atlantic Coast; 2) Link current conservation of birds in the South Atlantic Coast District regions with regional bird conservation plans already developed; 3) Improve data acquisition, database storage and accessibility; 4) Engage local communities to promote conservation alongside of recreational and economic interests; and 5) Improve our abilities to integrate issues of scale, including local, regional and national impacts of Corps activities on the conservation of many waterbirds and shorebird populations.

15. SUBJECT TERMS

Cadastral

Cadastre

COGO

Geographical information system

GIS

Real Estate

Real estate management information system

REMIS

Spatial data conversion